農業研究

第十二卷　第三期

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民國五十一年度臺灣省中南部二期作田間藥劑防治三化螟
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大螟 (*Sesamia inferens*) 試驗報告……………………陶家驊……52

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STUDIES ON THE CHARACTERISTICS AND CHROMOSOME NUMBERS OF SOME *GLYCINE* SPP. *

by

Y. W. CHENG**

The cultivated soybeans belong in the species *Glycine max.* Many other species of the genus *Glycine* have been identified, but their exact classification of some species still remain in doubt. It is considered that *Glycine ussuriensis* Regel and Maack and *Glycine gracilis* Skvortzov are closely related to the cultivated soybeans, *G. max.* The species *G. ussuriensis*, which has slender plant with twinning habit of growth, purple flower, oblong, small, hard, sooty, black seed, grows wild in Korea, northern part of Japan and northeastern Provinces of China and which has been believed to be the progenitor of the cultivated forms. The species *G. gracilis*, which has a low-growing plant, slender stem with smaller trifoliate leaves in comparision with the cultivated species, grows in northeastern Provinces of China, and has the intermediate characteristics between both *G. ussuriensis* and *G. max.* In addition to the two species mentioned above, it was also wildely accepted that *Glycine formosana* Hosokawa, is one of the *Glycine* species found in subtropical Taiwan, and was considered as one of the most closely related varieties to the cultivated forms. According to Tang and Lin[(2)] in their late paper, the *G. formosana* is very similar to the *G. ussuriensis* in morphological characteristics, they are but ecotypes of same species. All the three species grow annually containing 40 somatic chromosomes. The materials used in this study are perennial, origionally collected from Australia, Africa, South America, Sudan, and India.

Materials and Methods

Twenty strains of seven wild species in the genus *Glycine* were used in this study. The seeds were furnished by U. S. Regional Soybean Laboratory in Urbana, Illinois, upon the author's special request in 1960. The name of species, strain numbers and the sources of origin are listed below:

Species	Strain no.	Source of origin
Glycine borianii Baker	PI 249680	Sudan
Glycine clandestina Wendl	PI 233138	Australia
Glycine falcata Benth	PI 246591	Australia

* The author is grateful to The National Council on Science Development for its financial support.
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Glycine javanica L.	PI 156055	Southern Rhodesia
Glycine javanica L.	PI 213256	India
Glycine javanica L.	PI 213257	India
Glycine javanica L.	PI 224979	South Africa
Glycine javanica L.	PI 224980	Southern Rhodesia
Glycine javanica L.	PI 224981	Southern Rhodesia
Glycine javanica L.	PI 230325	South Africa
Glycine javanica L.	PI 234874	Congo
Glycine javanica L.	PI 234876	Congo
Glycine javanica L.	PI 245005	Uganda
Glycine javanica L.	PI 247676	Congo
Glycine javanica L.	PI 258381	Africa
Glycine javanica L.	PI 259546	Brazil
Glycine javanica L.	FC 32821	Unknown
Glycine tabacina Benth	PI 193232	Australia
Glycine tomentella Hayata	PI 233051	Taiwan, China
Glycine tomentosa Benth	PI 253238	Australia

The items of research in this study included morphological characters, growth habit, and the determining the chromosome numbers of the wild species. The seeds of each strain were sown in pots respectively on July 21, 1961. In order to overcome the hardseededness of the wild species, all seeds were given a scarifying treatment by chipping a small portion of the seed coat with a needle so as to facilitate the penetration of water and germination of seeds. For the study on the characteristics, 20 days after the seedling emerged from soil, four seedlings of each strain were transplanted in pots separately. The chromosome numbers of some strains of the wild species were determined by counts from pollen mother cells while some others from both root-tips and pollen mother cell smears. The flower buds were killed and fixed in a 3: 1 solution of 95% ethyl alcohol and glacial acetic acid for about 30 minutes and stored in 70% alcohol. The root-tips were collected from germinating seeds and fixed immidiately in 3:1 acetic-alcohol fixative, and stained with aceto-carmine when the pollen mother cell smears and root-tip smears.

Results

The wild species of the genus *Glycine* have the general characters of Leguminosae, but in some characters, they are quite different. In comparision with the cultivated species, *G. max*, greater differences were found in some characters in the wild species. Those have the greatest difference in the characters of the wild forms reported in this paper are all perennial plants except *G. borianii*. They could grow perennially under the natural environment of Taiwan. The flowering of the wild species lasted a long period, and the flowering dates of some strains scattered in the long period,if temperature changes rapidly. The maturity of seeds of some

Table 1. The chracteristics of some *Glycine* spp.

Species	Strain no.	Flower color	Leaflet shape	Pubscence	
				Type	Color
G. borianii	PI 249680	Pink	Lanceolate	Appressed	Gray
G. clandestina	PI 233138	Purple	Linear	Puberulent	Tawny
G. falcata	PI 246591	Dilute purple	Lanceolate	Appressed	Gray
G. javanica	FC 32821	White (PT)*	Oval	Appressed	Tawny
G. javanica	PI 156055	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 213256	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 213257	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 224979	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 224980	White (LGT)**	Oval	Appressed	Tawny
G. javanica	PI 224981	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 230325	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 234874	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 234876	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 245005	White (PT)	Oval	Appressed	Tawny
G. jaaanica	PI 247676	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 258381	White (PT)	Oval	Appressed	Tawny
G. javanica	PI 259546	White (PT)	Oval	Appressed	Gray
G. tabacina	PI 193232	Dark purple	Obovate, Lanceolate	Puberulent	Tawny
G. tomentella	PI 233051	Dark purple	Elliptic	Normal	Tawny
G. tomentosa	PI 253238	Purple	Oval	Appressed	Tawny

Strain no.	Growth habit	Annual or perennial	Seed coat color	No. of seeds per pod	Weight per 100 seeds (g)	Days to flower	Days to maturity
PI 249680	Climbing	Annual	Buff, Brown	2	1.31	99	154
PI 233138	Twinning	Perennial	Dark brown	2–8	0.30	51	109
PI 246591	Weak climbing	Perennial	Black	1–4	1.48	54	143
FC 32821	Twinning	Perennial	Light brown	1–6	0.86	105	190–207
PI 156055	Twinning	Perennial	Dark brown	2–7	0.93	107	190–207
PI 213256	Twinning	Perennial	Light brown	2–6	0.84	117	190–241
PI 213257	Twinning	Perennial	Light brown	1–6	0.78	117	190–218
PI 224979	Twinning	Perennial	Brown	1–7	0.85	115	190–258
PI 224980	Twinning	Perennial	Light brown	2–5	1.27	98	159–227
PI 224981	Twinning	Perennial	Dark brown	1–7	0.94	111	190–258
PI 230325	Twinning	Perennial	Dark brown	2–6	0.88	75	135–200
PI 234874	Twinning	Perennial	Brown	1–7	0.63	115	190–246
PI 234876	Twinning	Perennial	Light brown	1–7	0.78	113	190–241
PI 245005	Twinning	Perennial	Brown	1–6	0.75	124	190–218
PI 247676	Twinning	Perennial	Dark brown	1–6	0.55	118	190–258
PI 258381	Twinning	Perennial	Light brown	2–7	0.77	118	190–218
PI 259546	Twinning	Perennial	Dark brown	2–5	1.00	99	161–213
PI 193232	Climbing	Perennial	Black brown	1–5	0.56	90	138–205
PI 233051	Climbing	Perennial	Dark brown	2–5	0.70	73	120–184
PI 253238	Twinning	Perennial	Dark brown	2–5	0.65	60	102–151

* White (PT)=White flower with purple throat.

** White (LGT)=White flower with light green throat.

wild forms were not uniform for their long flowering period. Consequently, in many strains, harvesting of seeds dividing into several times. The growth habit of twinning or climbing stems was found in all the wild species. At the seedling stage they grew slowly and then became very vigorous after this stage, especially so in the species *G. javanica* and *G. tomentosa.* Although the species *G. clandestina* had very small leaves and fine stem, its twinning habit was strong after seedling stage. Besides the characters mentioned above, the wild forms had small, hard, dark-colored seed, black or brown pod, 2–8 seeded-pod. The plant characters in detail are shown in Table 1, Fig. 1, 2, and 3.

The determination of chromosome numbers in the wild species were made by counts from pollen mother cell smear. or from both pollen mother cell and root-tip smears. The species *G. tomentosa, G. falcata* and *G. clandestina* had the same chromosomes numbers being n=20; both of the species*G. tabacina* and *G. tomentella* had the same chromosome numbers being n=40. In the population of *G. javanica,* 14 strains were used in this study for chromosome counts, seven out of fourteen strains had n=11 chromosomes, the other sevenstrains had double chromosome numbers being n=22. The species *G. borianii* hadn=11 chromosomes in pollen mother cells, and 2n=22 chromosomes by countsobtained from root-tip smears. The name of species, strain number, chromosome numbers and the photomicrographs of pollen mother cells and root-tip cells areshown in Table 2 and Fig. 3 respectively.

Table 2. The chromosome numbers of some *Glycine* spp.

Species	Strain no.	Chromosome no.
G. boaianii	PI 249680	n=11; 2n=22
G. clandestina	PI 233138	n=20
G. falcata	PI 246591	n=20
G. javanica	FC 32821	n=22
G. javanica	PI 156055	n=22
G. javanica	PI 213256	n=11
G. javanica	PI 213257	n=11; 2n=22
G. javanica	PI 224979	n=22
G. javanica	PI 224980	n=11
G. javanica	PI 224981	n=11
G. javanica	PI 230325	n=11
G. javanica	PI 234874	n=22
G. javanica	PI 234876	n=22
G. javanica	PI 245005	n=11
G. javanica	PI 247676	n=22
G. javanica	PI 258381	n=11
G. javanica	PI 259546	n=22

G. tabacina	PI 193232	n=40
G. tomentella	PI 233051	n=40
G. tomentosa	PI 253238	n=20

Discussion

Seven wild species in the genus *Glycine* were used in this study. On the comparative study of the characteristics among the *Glycine* spp., their qualitative characters had little variations. The pubescence type, color, and flower color of the wild species were similar to that of the cultivated forms. On the other hand, the quantitative characters, such as flowering date and period, maturity and the weight per 100 seeds, had significant variations either among the wild species or between the wild and cultivated forms. Significant differences in the quantitative characters within the population of *G. javanica* were found.

The chromosome counts were made on aceto-carmine smears in meiotic or meitotic stage. Among the seven wild species in this study, *G. falcata*, *G. clandestina* and *G. tomentosa*, had the same chromosome number, n=20. The basic number of chromosome of the genus *Glycine* is x=10. Therefore the three species of n=20 sould be diploid forms. *G. tabacina* and *G. tomentella*, had n=40 chromosomes, should be tetraploid forms. In the population of *G. javanica*, 14 strains were used for chromosome counts, among which seven strains had n=11 chromosomes while the other seven strains had n=22 chromosomes. The strain PI 249680 of the species *G. borianii* also had n=11 chromosomes. In general, good fertility were obtained in the strains of both *G. javanica* and *G. borianii*. Therefore, there may be some uncertainties whether in the classification or in the basic number of chromosome in the genus *Glycine*. Especially the basic number of chromosome of *G. javanica* and *G. borianii*, is a very interesting problem, pending further study.

Acknowledgements

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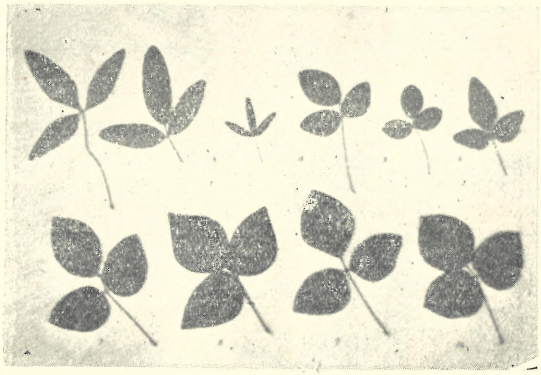
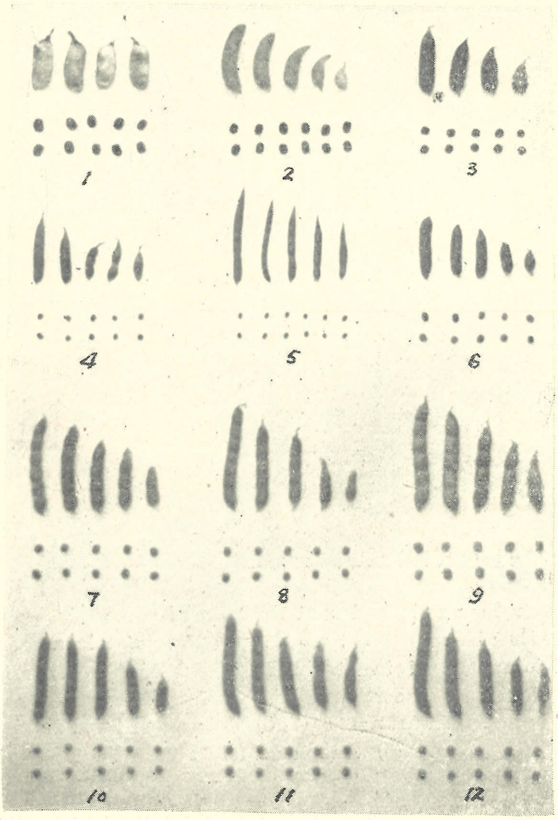
Fig. 1. The plants of some *Glycine* spp. (A) *Glycine tabacina*, PI 193232. (B) *Glycine borianii*, PI 249680. (C) *Glycine tomentosa* PI 253238. (D) *Glycine clandestina* PI 233138. (E) *Glycine tomentella*, PI 233051. (F) *Glyain falcata*, PI 230983. (G) *Glycine javanica*, FC 32821. (H) *Glycine javanica*, PI 156055. (I) *Glycine javanica*, PI 213256. (J) *Glycine javanica*, PI 213257.



(1) *G. falcata*
(2) *G. borianii*
(3) *G. clandestina*
(4) *G. tomentosa*
(5) *G. tabacina*
(6) *G. tomentella*
(7-10) *G. javanica*

Fig. 2. The leaf shape of some *Glycine* spp.



(1) *G. borianii*
(2) *G. falcata*
(3) *G. tomentosa*
(4) *G. tabacina*
(5) *G. clandestina*
(6) *G. tomentella*
(7) *G. javanica*, PI 259546
(8) *G. javanica*, PI 224979
(9) *G. javanica*, PI 224980
(10) *G. javanica*, PI 234874
(11) *G. javanica*, PI 247676
(12) *G. javanica*, PI 224981

Fig. 3. The shapes of pod and seed of some *Glycine* spp.

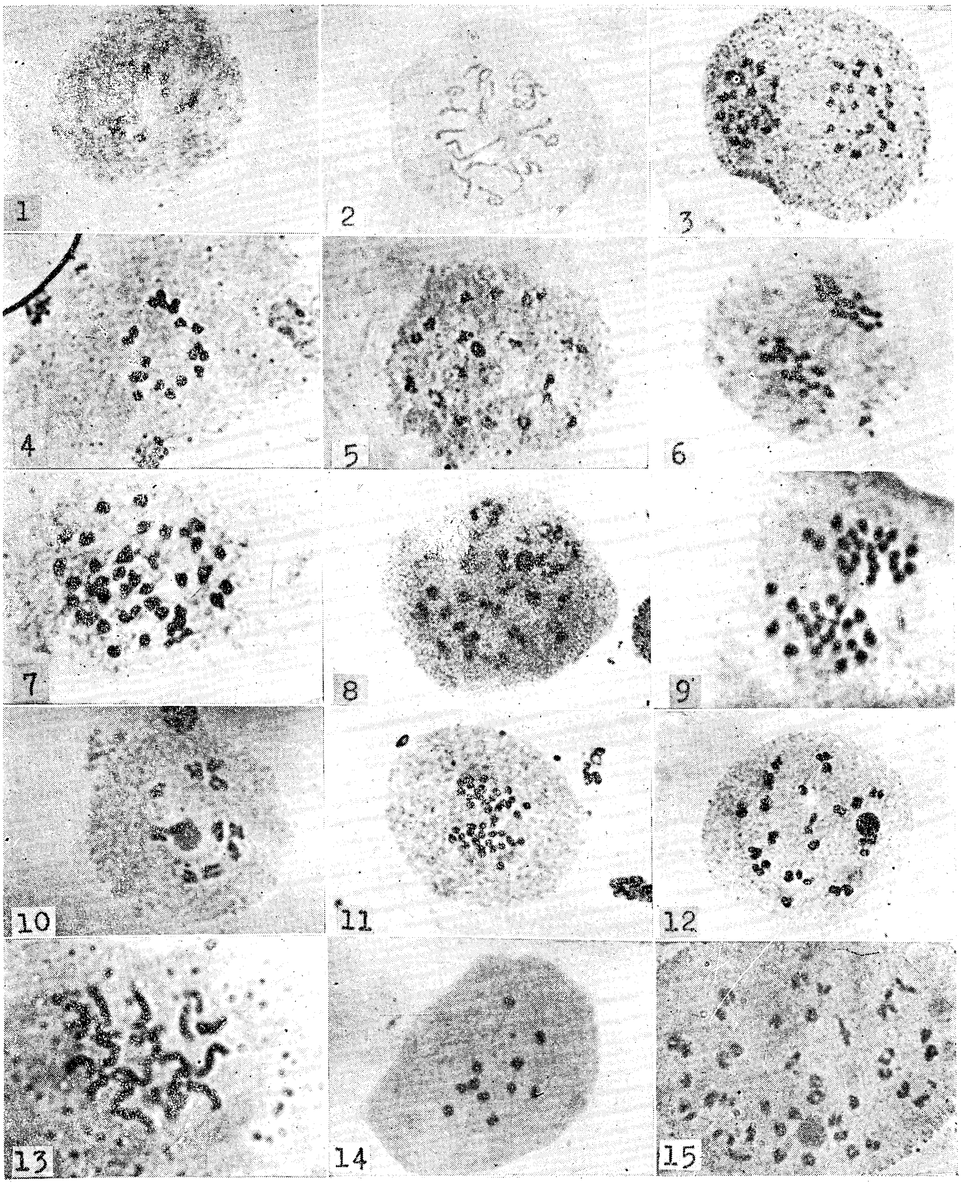


Fig. 4. The photomicrographs of pollen mother cells and root-tip cells of some *Glycine* spp. (1) Metaphase I in strain PI 249680 of *G. tomentella*, n=11. (2) Prophase in a root-tip cell of PI 249680, 2n=22. (3) Metaphase II in strain PI 233138 of *G. clandestina*, n=20. (4, 5) Metaphase I and diakinesis in strain PI 253238 of *G. tomentosa*, n=20. (6) Anaphase I in strain PI 246591 of *G. falcata*, n=20 (7, 8) Metaphase I and diakinesis in strain PI 193232 of *G. tabacina*, n=40. (9) Anaphase I in strain FC 32821 of *G. javanica*, n=22. (10) Diakinesis in strain PI 213256 of *G. javanica*, n=11. (11) Anaphase I in strain PI 156055 of *G. javanica*, n=22. (12) Diakinesis in strain PI 238744 of *G. javanica*, n=22. (13) Metaphase in a root-tip cell of strain PI 213257 of *G. javanica*, 2n=22. (14) Metaphase I in strain PI 230325, n=11. (15) Diakinesis in strain PI 233051 of *G. tomentella*, n=40.

大豆野生種染色體數目及植物性狀之研究

鄭　玉　威

摘　要

本研究供試大豆屬野生種，係由美國聯邦大豆地區試驗所 (U. S. Regional Soybean Laboratory) 所分贈，供試材料包括 7 個 Species 共計 20 個品系，計有 *Glycine borianii*，*Glycine clandestina*，*Glycine falcata*，*Glycine javanica*，*Glycine tabacina*，*Glycine tomentella* 及 *Glycine tomentosa*。其中 *G. javanica* 供試品種有 14 品系。其研究方法爲分別調查現有收集大豆屬野生種之植物形態，生長，繁殖，以及利用 Smear method 用 Aceto-carmine 染色，檢查花粉母細胞或根端細胞，以確定其染色體數目。

本研究應用之各大豆屬野生種，均有豆科植物通性，與大豆栽培種比較，有顯著差別，本研究所用之野生種，除 *G. borianii* 外其餘具有多年生習性，在臺灣之自然環境下，可作多年生生長，開花期長而零散，似受氣溫影響而變化甚大，豆莢成熟期多不整齊，多數品系種子均分成數期採收。

各野生種均具有强烈蔓生攀緣成葡蔔習性。苗期生長緩慢，後期生長勢强，其中尤以 *G. javanica*，*G. tomentosa* 最强；*G. clandestina* 莖葉極爲細小，後期生長旺盛。各野生種種子粒小，豆莢爲黑或褐色，每莢種子爲 2～8 粒不等，種皮黑或褐色，其染色體數目列簡表如下：

種　　名	染　色　體　數
G. borianii	n=11；2n=22（根端細胞檢查）
G. clandestina	n=20
G. falcata	n=20
G. javanica	7 個品系 n=11；7 個品系 n=22
G. tabacina	n=40
G. tomentella	n=40
G. tomentosa	n=20

臺灣之藥用植物

第一報　對腎石或膀胱結石有治療效果之 *Clerodendrum calamitosum* L.

洪　祖　仁

一、前　　言

本省南部有一種在日據時代自爪哇引進之藥用植物之栽培，俗稱「卡地布典」（音譯）或化石草。據云葉片之煎汁對腎石或膀胱結石之治療極爲有效。惜本省尙無前人考證本植物之學名，致無法搜集有關文獻並檢討其價値之機會。迨民國51年8月，作者根據在臺北獲得之標本進行鑑定結果，確認其爲馬鞭草科之 *Clerodendrum calamitosum* L.。玆誌其名稱，自然分佈，引進經過，形態、藥效及栽培等情形於後，俾供各界有關人士參考。

二、名　　稱

學　　名：*Clerodendrum calamitosum* L.
爪 哇 名：ketji beling
馬 來 名：kajoe gambir
臺灣俗稱：卡地布典（音譯），化石草

屬名 Clerodendrum 初見於1753年 C. Linne (1707～1778)之著作 "Species Plantarum"。嗣後於1763年經 Michel Adanson 改併爲 Clerodendron，後世學者乃沿用之。但根據萬國植物訂名規則（第3版），Clerodendron 爲無效，應採用 C. Linne 之 Clerodendrum。關於學名之意義，在1862年出版之 Curtis's Botanical Magazine Vol. XVIII 說明如下。

Inquires are often made by why species of Clerodendron have received the specific names of *fortunatum*, *infortunatum*, and *calamitosum*. The earlier known species were supposed to have medicinal properties, and of various qualities; and hence the generic name, from *κληρος*, *a lot*, or *anything used in determining chances*, and δενδρον, *a tree*. The first of the species just named, being good for colic, was called *fortunatum*, two suspected of being injurious or poisonous were called *infortunatum* and *calamitosum*.

（註）：*κληρος=cleros*, *δενδρον=dendron*

calamitosum=causing loss, destrucrive, suffering great loss, miserable

爪哇名 ketji beling，乃 making small 之義，據 K. Heyne 記載其在爪哇稱爲 ketji beling 著，非僅 *Clerodendendrum calamitosum* 一種，而係另有同樣藥效之四種同名異物植物 (Homonymous plant)。J. Kloppenburg-Versteegh 爲求區別起見，將其中三種加註號碼。（如下表）

List of homonymous plants "ketji beling" described by K. Heyne

Scientific name	Family name	Names appeared in "Atras van Indische Geneeskrachtige" by J. Kloppenburg-Versteegh

Desmodium gangeticum DC.	Leguminosae	ketji beling No. 1
Clerodendrum calamitosum L.	Verbenaceae	ketji beling No. 2
Hemigraphis colorata Hall. f.	Acanthaceae	kedji beling
Ruellia napifera Zoll. et Mor.	〃	ketji beling No. 3
Strobiranthes crispus Blume	〃	kedji beling

在臺灣俗稱之「卡地布典」實卽爪哇名 ketji beling 之轉訛語。「化石草」之意義爲消除腎石或膀胱結石之藥草，但此名不僅指稱 *Clerodendrum calamitosum* L，亦指唇形科之 *Orthosiphon stamineus* Benthum（中名：貓鬚草，苦芩，馬來名：kumis kuching）。

三、自然分佈及引入經過

原產：Java

分佈：Basilan, Borneo, Luzon, Malacca, Sumatra

在爪哇，*Clerodendrum calamitosum* 分佈於平原至海拔 750 m 之間，尤以東季風强烈之地爲多，屢生於靠近人類居住區，例如村落，椰子園，叢林或路傍之遮蔭等地。

作者曾向多方面進行調查結果，*Clerodendrum calamitosum* 係現住臺中市郊之廖以銳氏自東部爪哇 Malang 州引入。據廖氏談述，其於爪哇居留期間，一德國籍鄰人告知 *Clerodendrum calamitosum* 對腎石或膀胱結石有良好之治療效果，因此民國15年12月返臺省親之際曾引入若干株，但此次引種由於生育不良（可能移植不合時令），終告失敗。今日在本省栽培之 *Clerodendrum calamitosum*，卽由廖氏於民國22（或23？）年，再自爪哇引入之植株繁殖者。又廖氏在日據時代曾分讓植株給其友人陳慶春氏，（高雄州潮州郡枋寮庄水底寮，慶春農園主，民國32年歿），今日分佈在南部各地者，可能係經由慶春農園傳出。

四、形　　態

性狀；　直立性小灌木，株高通常在 0.5～1.0m。小枝橫截面呈鈍四稜形。地下具有匍匐地下莖。

葉部；　對生，單葉，缺托葉，葉形爲橢圓，長橢圓或倒卵形，長 6～10 cm，寬 4～8 cm，基部全緣，中部以上有不整齊之鋸齒緣，基部形狀爲楔形或漸鈍形，葉頂呈鈍形或稍尖形。羽狀脈，葉脈隆起不顯著，葉面呈皺狀，葉表略具絨毛，葉背光滑惟葉脈部份具絨毛。葉柄長 3.0 cm 左右，密佈絨毛。花部；花穗爲軸生，聚繖花序，花萼密佈絨毛，深裂爲 5 裂片，呈披針形，頂部頗尖，長 1.0 cm 左右，初爲綠色後漸變爲朱紅色。花冠筒狀部細長，長 2.0～3.0 cm，裂片呈匙形，色白，長 0.8～1.0 cm，雄蕊 4 枚，長，着生於花冠喉部，雌蕊柱頭部淺裂爲叉狀。子房爲不完全 4 室，核果爲漿果狀，徑約 8mm，在臺灣10月左右開花。

五、藥　　效

有關 *Clerodendrum calamitosum* 藥效之文献不多，其中可資吾人參考者，有 K. Heyne 之 "De Nuttige Planten van Nederlandsch Indië"，該書引用二、三位荷蘭科學者對 ketji beling 治療效果之記述，其大要如下。

A. G. Vorderman: 某腎石患者因炎症引起化膿，經過醫師診斷結果，認爲除動手術以外，再無其他治療方法，但該患者依照爪哇習慣，服用某種 daoen ketji beling 與 daoen oerat（見註 1）之混合煎汁，經過若干月後果然奏效，卽初主張動手術之醫生亦深以服用此混合煎汁奏效爲奇。但 A. G. Vorderman 尙不敢斷定係 ketji beling 之效果，而猜測或爲 daoen oerat 之效果所致。(Teysmannia, 1900, p. 217)

W. G. Boorsma 就各種 ketji beling 與其他利尿劑試驗其成份與藥效間之關係，同時另以富於鉀鹽之 daoen oerat 與 daoen meniran（見註2）作同樣之試驗。(Onderzoek naar de Plantenstoffen van Nederlandsch-Indië, Mededeelingen uit's Lands Plantentuin No. LII, 1902, p. 22)

A. G. Vorderman 在 "Tijdshrift voor Inlandsch Geneeskundigen, 1900, p. 51" 中記載： ketji beling 實爲治療腎石或膀胱結石之良好藥材，結石之種類不論爲尿酸鹽，磷酸鹽或草酸鹽均俱有同樣之效果，此點竟合居住爪哇之歐洲人亦深信不疑。

J. Kloppenburg-Versteegh 在 "Indische Planten en haar Geneeskracht, 3e druk" 中記載各種 ketji beling，以 *Clerodendrum caalmitosum* 之藥效最爲顯著，其葉片雖亦可單獨製成煎汁服用，但若配用 *Desmodium gangeticum* DC. 及 daoen meniran，可藉此提高其藥效。

據角倉記載，*Clerodendrum calamitosum* 係一有毒植物，此語或係僅就學名之意義來解釋，蓋本省服用此藥人數不少，迄今從未聞有中毒情事之發生。

（註1）：daoen oerat, daoen＝葉片， oerat＝*Plantago major*（車前草）

（註2）：meniran＝*Phyllanthus Niruri* L. 或 *Ph. Urinaria* L.

六、栽　　培

作者爲搜集有關 *Clerodendrum calamitosum* 資料，曾赴高雄，屏東等地調查，根據獲得之資料判斷，其栽培多在屏東縣，偶聞其他地方亦有栽培，但數量極少，大部份限於自用及兼作觀賞爲目的，其中僅小部份以營利爲目的。惟其栽培限於一小部份之主要原因在栽培者多不肯分讓或售出植株或繁植體。營利栽培者將採摘之葉片陰乾後往往混入若干 kumis kuching 之葉片出售。

Clerodendrum calamitosum 爲一種熱帶植物，耐寒性脆弱，在本省適於平地栽培，南部之氣候條件遠較北部爲優。在日照不足之地使葉片中之成份減低，固非理想之環境，反之過於强烈之日照亦會妨害葉片之健全發育，故需輕度之遮蔭，若利用爲果樹園等之間作，則甚爲理想。至於適當之栽培土壤尙無確切資料可稽。但一般在表土深厚，富於腐植質，排水佳良而能常時保持適當濕度之土壤似乎可得良好結果。葉片之採摘宜於初夏至開花前在營養生長盛期分次行之。株高通常在 0.5-1.0m，但作者在屏東縣枋寮鄉所見之老株，高達 2m 以上，此卽冬季未行更新主幹，翌年再任由主幹上部發生新梢所致。在同縣內埔鄉某農家所見者與前者相反，因其於秋前剪斷已採摘葉片之主幹，使植株基部伸長更新枝，併加强施肥，可避免冬季減少落葉之虞。

Clerodendrum calamitosum 在地下部產生匍匐莖而隔一段距離處向地上伸出成新枝，若不行分株，若不行分株卽長成叢。分株法卽利用此習性之繁殖法，其步驟簡單，在春末至夏季間揀擇株高 30 cm 左右之新株分割，但緊靠母株之新株根部未能充分發達，宜避免使用。秋季以後之移植不易成活應避免。除分割法以外，扦插亦可應用，卽揀擇 15～20 cm 之綠枝插於砂床卽可，至於其時期依地方而異，在南部一月下旬卽可開始扦插。

在臺灣開花後易結實，實生法亦可考慮用作繁殖，但其發芽習性及播種方法尙有研究之餘地。

Clerodendrum calamitosum 除供藥用外，雖無同屬植物 *C. Thomsonae* Balf.（中名：眞珠寶蓮，在本省各地常見之常綠纏繞性觀賞用植物）之華麗，但其樹姿及花有一種含蓄之美，在爪哇，馬來等地多栽植於庭園，以供觀賞，作者認爲不但適於庭園角落栽培，亦可配植於學校，公園等公共場所之花壇。

七、摘　　要

在本省南部偶而可見栽培之「卡地布典」，係廖以銳氏自爪哇引進之藥用植物，其葉片之煎汁

對治療腎石或膀胱結石極有效。作者根據在臺北獲得之標本進行鑑定結果，確認其爲馬鞭草科之 *Clerodendrum calamitosum* L.。惟俗稱「卡地布典」，實乃爪哇名 ketji beling 之轉訛語。

誌　謝

本研究蒙本所所長徐博士水泉及農藝系楊技士永裕不斷鼓勵，併承國立臺灣大學陳貴，陳建鑄及曹永和先生分別在提供標本，繪圖及荷文翻譯方面惠予協助。本文復蒙本所農藝系主任謝博士順景及國立臺灣大學森林學系廖講師日京校閱，一併在此謹申謝意。

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ON MEDICINAL PLANTS OF TAIWAN

I. Some Notes on the Medicinal Plant *Clerodendrum calamitosum* L. in Treating the Renal or Vesical Calculi

by

TSU-JEN HUNG

Summary

A species of medicinal plant introduced from Java by Mr. I-Jui Liao (廖以銳) being called "kachipten" in Taiwan, is cultivated in southern parts of this Island. It is said that a decoction of leaves has a good clinical effect in patients with kidney or bladder stone.

With use of specimen planted in Taipei for determination, the author identified this plant to be *Clerodendrum calamitosum* L. (Verbenaceae). The author considers that the name "Kachipten" is a corrupt word of Javan name "ketji beling".

Clerodendrum calamitosum Linn. Mant. Vol. I, p. 90 (1767); DC. Prodr. Vol. XI, p. 663, (1847); Curtis's Botanical Magazine Vol. XVIII, Tab. 5294, (1862); Miquel, F. A. W., Flora van Nederlandsch Indië Vol. II, p. 870, (1856); Lam, H. J., The Verbenaceae of the Malay Archipelago, pp. 256–258, (1919).

C. eriosiphon Schauer, DC. Prodr. Vol. XI, p. 662, (1847); Miquel, F. A. W., Flora van Nederlandsch Indië, Vol. II, p. 869, (1856).

C. obtusidense Miquel, Flora van Nederlandscd Indië, Vol. II, p. 870, (1856).

Habit: An upright shrub, soboliferous, 0.5–1.0m. high; Trunk erected; Branchlet obtusely quadrangular; Leaves opposite and some what rugose, elliptic, oblong, or obovate shape, 6–10 cm. long and 4–8 cm. wide, acute or narrowly obtuse at the base, obtuse or shortly acute at the apex, the upper to ¾ parts of margin with coasely serrated or somewhat with irregular teethed, veins pinnately, thinly pubescent at the upper surface and usually glabrous below except veins, petioles up to 3 cm. long covered with minutely pubescent; Inflorescene cyme, axillary, pedicel about 1 cm. long, calyx 5-parted on very slender pedicel, sepal lanceolate, very acute at the apex with pubescent, corolla tube cylindric, slender about 2.0–3.0 cm. long, white, lobes spatulate shape and about 0.8–1.0 cm. long, stamens 4, about 2.0–2.5 cm. long attached in the throat and very exserted, anther with 2–celled and longitudinal dehiscence, style with shortly bifid stigma; Fruit berry-like drupe, globose, about 0.8 cm. across, seated on the enlarged calyx, the sepal of which are reflexed.

Fig. *Clerodendrum calamitosum* L.

a. branchlet with leaves and flowers
b. leaf (upper surface)
c. leaf (under surface)
d. flower (×1.5)
e. flower (vertical section)
f. segment of calyx (×3.5)
g. anther (dorsal view)
h. anther (side view)
i. anther (ventral view)
j. pistil and calyx
k. ovary
l. ovary (vertical section)
m. ovary (cross section)

矽對水稻之效應(第二報)

連　　深

引　　言

矽對水稻效應之研究，日本近年來報告甚多。一向棄去之製鐵鑛滓 (Slag) 已變爲有價值之矽肥源。據云[1]日本現在施用水田之鑛滓每年達100萬噸對於水稻增產頗有貢獻。

鑛滓對水稻增產之實際情形，據[2]日本全國農事試驗場104個試驗所得平均爲9%，另據小幡氏在富山縣53個試驗所得平均爲11%，但此種效果實際上依試驗田有效態矽酸供應能力之不同而異。據云[3]退化水田，泥炭地水田及花崗岩，石英斑岩爲母質的砂質水田均甚缺乏有效態矽酸而火山灰和頁岩爲母質之水田則含量甚豐。其供應能力之大小可從稻藁，灌漑水以及土壤中可溶性矽酸之含量等而加以判定。鑛滓亦應針對着欠乏有效態矽酸之水田施用才能收到功效。

本省過去有關水稻之矽酸試驗研究甚少。作者曾於民國49~50年間在臺北、桃園兩地擔任鑛滓之肥效試驗結果證實矽對水稻收量確有增產效果[4]；在一般無顯著病害之田間情形下谷產量得到9%之增收，遇顯著病害效果益加顯著。爲進一步探討鑛滓對各地水稻之肥效情形並探討土壤中可溶性矽酸，及藁中矽酸含量和各地矽肥效應之關係乃增設試地繼續試驗，結果如下：

本試驗部份經費承農復會及國家長期發展科學委員會補助，試驗之進行復蒙國立臺灣大學教授張守敬博士指導，肥料研究室主持人林國謙先生鼓勵，並承臺北、新竹、臺中、臺南、高雄，各區改良場（臺北及臺南兩改良場由分場帮忙）及縣立中壢農校協助田間試驗，肥料研究室陳火塗先生協助分析工作，作者謹此誌謝。

供　試　鑛　滓

本試驗供試材料主要爲臺灣鍊鐵公司之高爐鑛滓。其產量年約一萬公噸，迄無用途，棄於河中。供試鑛滓成分如下：

表一　供試鑛滓分析成積

鑛　　滓	全量 (%)							½HCl 可溶** (%)		
	SiO_2	CaO	MgO	Al_2O_3	Fe_2O_3	MnO	S	SiO_2	CaO	MgO
供試省產高爐鑛滓(民國50年)	35.9	41.9	3.5	—	—	—	—	22.4	28.3	0.70
供試省產高爐鑛滓*(民國51年)	30.3-33.0	41.0-43.5	1.01-1.27	20.9-23.2	0.91-1.21	—	1.75-2.06	—	—	—
供試日產鑛滓	42.1	26.3	19.6	—	—	—	—	27.2	17.9	15.5

* 採自臺灣煉鐵公司七月份分析結果。
** 抽出液比例 1：150 時間：1小時，室溫。

由上表可見其成分以 CaO 和 SiO_2 即矽酸鈣爲主，佔總成分之¾。鋁爲其次約佔20%左右，此外尙有少量鎂、鐵、硫等。另一種供試日製鑛滓鎂含量較多但鈣相對減少。

一、矽酸及矽質鑛滓對各地水稻之增收效果

(1) 盆栽試驗

試驗(一)

方法：供試土壤爲臺北農試所水田之砂岩頁岩質沖積土 (pH 4.8)。每盆裝土5公斤，試驗設計

9 處理五重覆。N_1, N_2, N_3 各代表氮肥少量、中量及多量，每盆施氮素各 0.44，0.88，1.32克以硫酸銨供之。P_2O_5 及 K_2O 每盆均施 0.7 克以過燐酸鈣及硫酸鉀供之。Slag 施用量除對照區 (S_0) 不施鑛滓外少量區 (S_1) 及多量區 (S_2) 每盆各施鑛滓 12.8 及 25.6 克。

表二　鑛滓肥效盆栽試驗結果

處理別	穀收量 第一期作	指數	穀收量 第二期作	指數	藁收量 第一期作	指數	藁收量 第二期作	指數
N_1 鑛滓 O	18.7	100	15.2	100	30.9	100	40.2	100
N_1 鑛滓 S_1	19.8	106	17.2	113	27.3	88	45.9	114
N_1 鑛滓 S_2	18.3	98	12.6	83	25.2	82	43.7	109
N_2 鑛滓 O	15.2	81	10.4	68	36.1	116	43.5	108
N_2 鑛滓 S_1	18.2	97	19.5	128	38.0	123	61.2	152
N_2 鑛滓 S_2	25.1	134	15.8	104	40.1	130	46.6	116
N_3 鑛滓 O	11.8	63	10.3	68	42.1	136	49.7	124
N_3 鑛滓 S_1	21.5	115	20.4	134	47.7	154	53.9	134
N_3 鑛滓 S_2	29.4	157	18.4	121	47.7	154	52.4	131
L. S. D. 5%	4.19	—	5.20	—	5.02	—	14.63	—
L. S. D. 1%	5.61	—	6.97	—	6.73	—	10.52	—
$N_1+N_2+N_3$ S_0	15.2	100	12.0	100	36.3	100	44.5	100
$N_1+N_2+N_3$ S_1	19.3	127	19.1	159	37.7	104	53.7	121
$N_1+N_2+N_3$ S_2	24.2	159	16.6	138	37.7	104	47.6	107
L. S. D. 5%	3.24	—	4.02	—	N. S.	—	8.45	—
L. S. D. 1%	2.41	—	3.00	—		—	6.31	—
C. V. (%)	16.6		25.5		11.2		17.6	

生育過程中鑛滓區之水稻，外觀均較對照區略健。氮肥多量區而不施鑛滓者葉身下垂，顯得特別軟弱。由收量調查結果可見鑛滓區穀藁收量均較對照區顯著提高。鑛滓與氮肥交感亦爲顯著，表示鑛滓和氮肥之配合效果更大。

試驗㈡

方法：本試驗僅進行一期作（第一期作）。供試土壤及用盆均如試驗㈠。試驗共設 5 處理其中對照區及矽酸區 (Gel) 設六重覆，餘者各爲五重覆。肥料施用量各盆均施 N, P_2O_5, K_2O 各 0.7 : 0.5 : 0.5 克以硫酸銨，過燐酸鈣及硫酸鉀供之。鑛滓施用量 S_1, S_2, S_3 依次爲25，50，100克/盆。矽酸區施用膠狀矽酸 (Silica gel)，每盆實施 SiO_2 19.4 克（以乾 SiO_2 計算）。膠狀矽酸係矽酸鈉稀釋後以稀鹽酸中和後洗去 NaCl 所得。

結果及討論：

① 生育期間矽酸區及鑛滓區均較對照區略呈强健之勢，株高亦以前者稍高。

② 分蘗數及穗數：矽酸區與對照區間並無差異，惟鑛滓區依施用量之增加而有減少之傾向。

表三　各區分蘗數及穗數比較

處理區別	分蘗數（插秧後60日）	穗數（收穫期）	處理區別	分蘗數（插秧後60日）	穗數（收穫期）
O 對照區	29.2	24.5	G 矽酸區	29.0	24.7

S_1 鑛滓少量區	31.6	23.2	S_3鑛滓極多量區	26.6	19.6
S_2 鑛滓多量區	29.0	21.0			

表四　各區收量之比較

處理區別	穀收量(克/盆)	指數	藁收量(克/盆)	指數
O 對照區	29.7	100.0	46.2	100.0
G 矽酸區	35.3	118.7	55.3	119.8
S_1 鑛滓少量區	30.9	106.5	45.2	98.0
S_2 鑛滓多量區	33.5	112.9	44.8	97.1
S_3 鑛滓極多量區	33.8	113.9	45.7	98.9
L.S.D. {5% 1%}	1 {2.53 3.43　2 {2.65 2.61	3 {2.77 3.76	1 {4.09 5.56　2 {4.29 5.83	3 {4.48 6.09
C.V. (%)	6.44		7.17	

註：1. O 與 G 之間。2. O 或 G 與 S_1, S_2, S_3 之間。3. S_1, S_2, S_3 之間。

表五　各區收量調查結果**

調查項目 / 處理區別	穗長 (cm)	穗重 (克)	收量構成要素			
			一株穗數	一穗粒數	登熟率* (%)	千粒重 (克)
O	12.9	12.2	24.5	49.9	84.7	25.7
G	13.8	14.3	24.7	57.8	87.1	26.0
S_2	14.3	16.2	21.0	62.0	90.4	27.4

* 以比重1.06鹽水選別。　　**爲各處理區全部稻穗測定後之平均

③ 收量調查結果及討論：由表四可見膠狀矽酸和鑛滓對水稻谷藁收量均有顯著肥效。

茲就表五收量構成要素分別說明谷收量增收之機構如下：

i) 膠狀矽酸之效果：膠狀矽酸區與對照區二者在穗數上並無差別，惟前者穗重增加甚多故其收量得顯著增高。其穗重增加之因素係由於一穗粒數及登熟率之增加所致而以一穗粒數之影響最爲重要。矽酸區穗長之增加和其一穗粒數之增加甚爲符合。

就藁收量言之，因矽酸區穗數較對照區並無增加，故其收量（即重量）之增加當爲每枝藁稈重量之增加所致。據片山氏[5]，稻穗之大小和稈基重之大小有密切關係，；亦即莖之大小和穗之大小成正比例。若是則上述矽酸區每枝藁稈重量之增加，當爲一穗粒數乃至於登熟率（亦即穗重）增加之最大原因。

ii) 鑛滓之效果：鑛滓區谷收量隨其施用量而增大，但 S_2 區似爲界限。其收量構成要素中穗數顯然減低，但因一穗粒數，登熟率千粒重均有增加（亦即穗重增加），故收量仍較對照區增加。鑛滓區穗數之減少似與所含石灰成分有關：據[6]作者以前盆栽試驗結果，施用多量石灰石粉後穗數常有減少現象。

鑛滓區穗數雖較對照區減少，惟兩區間藁收量並不相上下，故前者每枝藁稈之重量當較後者爲大。藁稈旣然增大，則根據上述推測其所着稻穗亦當較大。其穗重增加之原因，似和矽酸區情形相同。

④ 收穫物分析結果。

表六　盆栽試驗收穫物分析成積

試驗處理區	SiO_2					N					
	藁		穀		吸收量合計	藁		穀		吸收量合計	轉移率(%)
	含有率(%)	吸收量(mg)	含有率(%)	吸收量(mg)	(mg)	含有率(%)	吸收量(mg)	含有率(%)	吸收量(mg)	(mg)	$\frac{\text{N in grian}}{\text{Tatal N absorbed}} \times 100$
O	3.52	1,475	1.46	402	1,877	0.778	326	1.13	311	637	48.8
G	7.66	3,943	2.96	969	4,912	0.643	331	1.11	363	694	52.3
S_1	6.30	2,519	2.13	611	3,130	0.612	253	1.12	322	575	56.0
S_2	7.37	3,064	2.59	804	3,868	0.553	230	1.11	345	575	60.0
S_3	9.08	3,527	3.10	971	4,498	0.563	218	1.12	351	569	61.6

① 膠狀矽酸和鑛滓之施用顯著提高了穀藁中 SiO_2 含量，同時亦大大的提高了吸收量。其吸收量之增加在稻藁部分最多。膠狀矽酸及 S_1 區鑛滓之 SiO_2 吸收率各爲 15.6 及 14.3%。

② 稻藁中之氮含量以及吸收量顯然因矽酸和鑛滓之施用（尤以後者）而略有減低。但其總吸收量之間却甚少差異。可見就水稻所吸收之氮素轉移穗中之比率而言膠狀矽酸和鑛滓各區均較對照區爲優。

(2) 田間試驗結果及討論

表七　桃園（中路）試驗地谷藁收量比較表（民國51年）(kg/ha)

處理區別		谷				藁			
		第一期作產量	指數	第二期作產量	指數	第一期作產量	指數	第二期作產量	指數
N_1	O	3,502	100	4,120	100	3,750	100	3,830	100
	S	4,013	115	4,315	105	3,550	95	3,830	100
	Sj	4,112	117	4,337	105	3,750	100	3,870	101
	Ca	3,572	102	3,832	93	3,270	87	3,500	91
N_2	O	3,927	100	4,098	100	3,700	100	3,850	100
	S	4,195	107	4,497	110	4,210	114	4,160	108
	Sj	4,538	116	4,442	108	4,370	118	3,930	102
	Ca	3,887	99	3,807	93	3,810	103	3,820	99
L.S.D.	5%	341		185		468		400	
	1%	457		248		627		538	
C.V.		7.3		3.8		10.5		8.9	

註：試驗方法：小區面積 10 m^2，隨機區集設計 6 重覆，N_1, N_2 各代表 N 施用量 60 及 120 kg/ha（第 2 期作爲 80 及 120 kg/ha）。P_2O_5 及 K_2O 各區均施 60 kg/ha。S 區及 Sj 區各施鑛滓及參試日製鑛滓各 2,500 kg/ha 及 2,150 kg/ha（二者實施 SiO_2 量相同）。Ca 區施用石灰石粉 2,000 kg/ha，Ca 區和 S 區所施 CaO 量實際上相同。第二期作 Sj 區並無繼續施用鑛滓，故其結果爲第一期作所施鑛滓之殘效。試驗係兩期作均於同一試區內舉行。

表八　臺北二重埔試驗地谷藁收量比較表（民國51年）(kg/ha)

處理區別		谷				藁			
		第一期產量	指數	第二期產量	指數	第一期產量	指數	第二期產量	指數
N_1	O	2,737	100	3,340	100	4,612	100	4,000	100

	S	3,117	114	3,637	109	4,783	104	4,170	104
	Ca	2,583	94	3,463	103	4,550	99	3,980	99.5
N$_2$	O	2,232	100	3,142	100	4,437	100	3,950	100
	S	2,445	110	3,493	112	5,000	113	4,480	113
	Ca	2,198	99	3,463	110	4,533	102	4,570	116
L. S. D.	5%	329		168		451		219	
	1%	441		226		606		294	
C. V. (%)		11.3		4.2		8.6		4.5	

註：試驗方法：同表 1。

表九　其他各試驗地谷收量比較表（民國50-51年）(kg/ha)

處理區別		羅東（冬山）				中壢（鎮）				新竹（湳雅）			
		二期		一期		二期		一期		二期		一期	
		kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
N$_0$	O	2,757	100	4,183	100	3,151	100	2,088	100	3,113	100	3,392	100
	S	2,739	99	4,278	102	3,230	103	2,305	110	3,313	106	3,470	102
	Ca	2,723	99	3,792	91	3,222	102	2,505	120	3,328	107	3,325	98
N$_1$	O	3,083	100	4,547	100	3,965	100	3,107	100	3,768	100	4,502	100
	S	3,184	103	4,900	108	3,882	98	3,462	111	3,780	100	4,378	97
	Ca	3,049	99	4,497	99	3,804	96	3,275	105	3,636	97	3,885	86
N$_2$	O	3,012	100	4,252	100	3,885	100	3,142	100	3,923	100	4,622	100
	S	3,100	103	5,120	120	3,992	103	3,527	112	4,098	105	4,887	106
	Ca	3,092	103	4,505	106	3,755	97	3,547	113	3,964	101	4,113	89
L. S. D.**	5%	不顯著		331		不顯著		239		不顯著		419	
	1%			443				321				561	
C. V. (%)		5.3		6.4		4.0		7.0		5.0		8.9	

處理區別		臺中（市）				嘉義（市）				屏東（麟洛）			
		二期		一期		二期		一期		二期*		一期	
		kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%	kg/ha	%
N$_0$	O	3,073	100	3,550	100	3,693	100	3,738	100	502	100	3,390	100
	S	2,926	95	3,358	94	3,785	102	3,662	98	479	95	3,420	101
	Ca	2,951	96	3,348	95	3,783	102	4,128	110	464	92	3,635	107
N$_1$	O	3,758	100	5,055	100	4,753	100	4,952	100	454	100	4,612	100
	S	3,870	103	5,015	100	4,928	104	4,484	91	427	94	4,438	96
	Ca	3,827	102	5,042	99	4,628	97	4,496	91	559	123	4,460	97
N$_2$	O	4,464	100	5,655	100	5,357	100	5,478	100	545	100	5,695	100
	S	4,528	101	5,690	101	5,367	100	5,444	99	512	94	5,418	95
	Ca	4,145	93	5,685	101	5,297	99	5,374	98	453	83	5,902	104

L. S. D.** {5%, 1%	不顯著	不顯著	不顯著	不顯著	不顯著	不顯著
C. V. (%)	5.0	5.2	6.1	9.2	30.0	9.9

註：試驗方法如表 1 (註) N_0, N_1, N_2 各代表每期作 N 施用量 0,60 及 120 kg/ha。
* 屏東第二期作曾遇水稻窒息病。
** 不顯著係就同氮素平準下各處理間之比較而言。

1. 鑛滓之肥效：

由以上結果可見 Slag 在臺北、桃園及冬山效果顯著，惟其他試驗地却否。其谷增收程度在氮肥施用量 60~80 kg/ha (即 N_1 平準) 下，三地平均第一二期作各爲 12%及 6%。因石灰石粉並無效果，故 Slag 之效果當歸於矽酸之成份最多。

上述三試驗地都在第一期作發生過輕度病蟲害，(以稻熱病爲主) 故 Slag 效果在第一期作特別顯著之原因顯然和矽酸增强水稻抗病蟲害之效果有關。又遇病蟲害發生時氮肥多量區罹病情形較重，Slag 之效果亦當特別顯著。

稻藁分析結果顯示上述試驗地 SiO_2 含量甚低 (5.5~9.0%) 而其他試驗地則高 (9.5~13%)。Slag 之效果和藁中 SiO_2 含量有關，另章說明。

Slag 肥效試驗在臺北、桃園兩地先後已有三年六作之成積；桃園試驗地係東埔 2 地點及中路 1 地點 (各兩期作) 之試驗結果，臺北則爲本所 1 地點 (連續 4 作) 及二重埔 1 地點 (兩期作) 之試驗結果。除中路及二重埔成績如表 1 及 2 外其餘已誌前報[4]。茲爲說明 Slag 肥效之便乃將上述結果合併得平均如下：

表十$_A$ 桃園、臺北歷年試驗結果平均 (kg/ha)

處理區別		桃園 3 試驗地點計 6 期作平均				臺北 2 試驗地點計 5 期作平均			
		谷收量	指數	藁收量	指數	谷收量	指數	藁收量	指數
N_1	O	3,816	100	3,601	100	2,754	100	3,913	100
	S	4,157	109	3,714	103	3,027	110	4,037	103
	Ca	3,797	100	3,358	93	2,801	102	3,851	98
N_2	O	3,767	100	3,723	100	2,741	100	4,103	100
	S	4,177	111	4,139	111	3,029	110	4,352	106
	Ca	3,724	99	3,595	97	2,825	103	4,250	104

表十$_B$ 同上試驗結果一、二期作別谷收量平均 (kg/ha)

處理區別		桃園 3 試驗地點計 6 期作				臺北 2 試驗地點計 5 期作			
		第一期作		第二期作		第一期作		第二期作	
		谷收量	指數	谷收量	指數	谷收量	指數	谷收量	指數
N_1	O	3,619	100	4,014	100	2,606	100	2,958	100
	S	4,021	111	4,293	107	2,897	111	3,201	108
	Ca	3,680	102	3,913	98	2,635	101	3,031	102
N_2	O	3,304	100	4,230	100	2,631	100	2,858	100
	S	3,826	116	4,528	107	2,886	110	3,206	112
	Ca	3,341	101	4,106	97	2,631	100	3,074	108

由上表可以更肯定的看出 Slag 在桃園、臺北地區對水稻增收確有功效，其增收率在一般施肥

狀態下（卽 N_1 level，爲 60～80 kg/ha）達 9～10%。藁收量亦略有增收（3%）。Slag 之效果仍以第一期作大於第二期作，在 N_1 施肥平準下各爲 11%及 7～8%。此種差異顯然和第一期作之易罹稻熱病害有關，亦由此可見增加水稻抗病效果顯然爲 Slag 肥效之重要因素。惟上述試驗並非常有顯著病蟲害發生，予料矽對水稻生育上促進之作用對此增收亦有貢献。盆栽試驗所得結果可爲證明。（盆栽試驗中並無病蟲害因素，但施用矽酸後每枝藁稈之平均重量及一穗重均增，故谷藁收量亦獲增加。）

退而言之卽使上述結果完全和病蟲害因素有關，亦因試驗旣於一般田間情形下進行，且歷年已得平穩之增產效果而值得應用上之重視。（氮素施用平準 N_1 level 與一般施用量相當）。

2. 氮肥施用量與 Slag 之連應：

由表 4 可見桃園、臺北兩地無論一、二期作氮素用量在 60～80 kg/ha 下已達限度，增施氮肥達 120 公斤並不能再獲增收。Slag 之配合亦未能提高其施用適量達此程度。

3. 兩種鑛滓肥效之比較：

由表 1 可見日產鑛滓（Sj）和省產鑛滓（S）谷增產指數分別爲 116 及 111，前者略優，但差異不顯著。由稻藁分析可見前者 SiO_2 含量略高，Slag 之 Solubility 亦以前者稍高。又前者含有多量之鎂，亦應予注意。

4. Slag 之殘效：

表 7 第 2 期作 Sj 區並未繼續施用日產鑛滓故其顯著肥效爲第一期作所遺留之殘效。另一殘效試驗（51年 1 期作）之結果如下：

表十一　殘效試驗結果

處理區別		谷收量	指數	藁收量	指數	處理區別		谷收量	指數	藁收量	指數
N_1	O	4,204	100	3,376	100	N_2	S_1	4,404	113	4,338	104
	S_1	4,352	104	3,436	102		S_2	4,474	115	4,486	107
	S_2	4,410	105	3,782	112		Ca_1	4,222	109	4,306	103
	Ca_1	4,382	104	3,436	102		Ca_2	4,656	120	4,650	111
	Ca_2	4,534	108	3,436	102	L. S. D.	5%	351		344	
							1%	473		463	
N_2	O	3,882	100	4,186	100	C. V.		6.3		6.7	

該項試驗係民國50年桃園東埔試驗地結束後繼續保留者。

由上面結果可見 Slag 和石灰石粉均有明顯殘效。石灰石粉在該試驗地元來並無肥效，却有殘效，原因有待求證。

二、藁中 SiO_2 含量與各試驗地鑛滓肥效之關係

表十二　各試驗地收穫時藁中 SiO_2 含量表

處理區別 ＼ 地點 / 期作別		臺北（本所A）			本所B	臺北（二重埔）		桃園（東埔）			桃園（中路）		龜山
		第一期	第二期	殘效 第一期	第一期	第一期	第二期	第一期	第二期	殘效 第一期	第一期	第二期	第一期
N_1	O	6.22	5.48	5.75	5.94	8.42	9.2	7.62	6.74	6.02	7.19	8.5	10.4
	S	7.27	8.00	7.55	7.85	10.25	10.3	9.03	9.37	7.74	8.56	11.7	11.1
	Sj	—	—	—	—	—	—	—	—	—	9.26	—	—

N_1	G	—	—	—	8.09	—	—	—	—	—	—	—	—
	Ca	6.11	—	—	—	—	—	8.19	—	—	—	—	—
N_2	O	4.24	4.39	—	—	—	8.3	7.57	6.32	—	6.74	7.9	—
	S	7.58	6.82	—	—	—	9.2	8.39	8.95	—	7.74	11.0	—
	Sj	—	—	—	—	—	—	—	—	—	8.28	—	—
	Ca	5.05	—	—	—	—	—	—	—	—	—	—	—

處理區別	地點 / 期作別	羅東		中壢		新竹		臺中		嘉義		屏東	
		第2期	第1期	第2期	第1期	第2期	第1期	第2期	第1期	第2期	第1期	第2期	第1期
N_0	O	6.68	6.49	11.7	—	9.52	7.98	—	10.5	11.2	—	14.3	13.6
	S	7.53	9.09	12.4	—	10.1	8.82	—	11.0	11.7	—	14.8	13.0
	Ca	—	—	—	—	—	—	—	—	—	—	—	—
N_1	O	5.74	6.26	10.1	6.80	8.99	7.36	11.8	9.80	11.7	9.05	13.4	13.2
	S	6.68	7.70	11.2	8.84	9.73	8.60	10.9	11.2	12.1	9.98	13.8	13.3
	Ca	—	6.32	—	—	—	—	—	—	—	—	—	—
N_2	O	5.54	5.19	8.5	6.60	8.63	6.73	8.8	8.66	11.3	9.58	12.7	13.2
	S	6.55	7.21	10.1	7.88	8.72	7.97	11.8	10.6	12.3	9.77	13.4	12.6
	Ca	—	—	—	—	—	—	—	—	—	—	—	—

註：SiO_2 之定量用重量法並以 dry matter %表示之。

由表12可見各試驗地稻藁之矽酸含量變化甚大（收獲時 5～14%）：臺北（本所及二重埔）桃園（東埔及中路）羅東（冬山）各地均低（5.5～9.0%）而屏東嘉義、臺中、龜山各地則高（9.5～13.5%），尤以屏東最高，每期作均在 13%以上。藁中 SiO_2 含有率和鑛滓肥效之間有甚密切之關係，可從歷年田間試驗所得結果及上述稻藁之分析得到概略說明。

表十三　各地稻藁收穫時之 SiO_2 含有率與鑛滓肥效之關係

第一期作（民國51年）谷產量（kg/ha）

處理	羅東（冬山）	中壢	新竹	臺中	嘉義	屏東（麟洛）	臺北*（本所A）	臺北**（本所B）	臺北（三重埔）	桃園（中路）	桃園*（東埔）	龜山
O	4,327	2,779	4,172	4,753	4,723	4,565	2,540	2,725	2,737	3,502	3,678	5,055
S	4,766	3,098	4,245	4,688	4,530	4,425	2,788	3,093	3,117	4,013	4,025	5,125
谷增收率 %	+ 10	+ 11	+ 2	− 1	− 4	− 3	+ 10	+ 14	+ 14	+ 15	+ 9	+ 1
稻藁 SiO_2 %	5.98	6.70	7.36	9.65	9.62	13.3	6.2	5.9	8.4	7.2	7.6	10.4

第二期作（民國50年）谷產量（kg/ha）

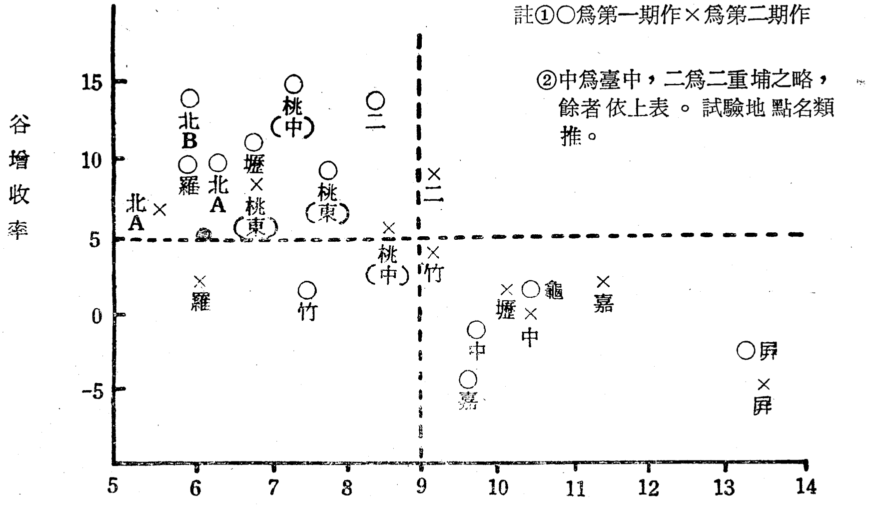
處理	羅東	中壢	新竹	臺中	嘉義	屏東	臺北本所A	臺北二重埔	桃園東埔*	桃園中路
O	2,951	3,669	3,602	3,767	4,601	500	2,575	3,340	3,961	4,120
S	3,008	3,703	3,732	3,777	4,693	473	2,765	3,637	4,282	4,315
谷增收率 %	+ 2	+ 1	+ 4	0	+ 2	− 5	+ 7	+ 9	+ 8	+ 5
稻藁 SiO_2 %	5.99	10.1	9.05	10.3	11.4	13.5	5.5	9.2	6.7	8.5

註：上述結果除羅東、中壢、新竹、臺中，嘉義及屏東係 N_0, N_1, N_2 三平準合併後之平均外餘者皆爲 N_1 平準下之數據。

* 印者其收量係兩年間之平均。

** 臺北試驗B係施用膠狀矽酸 5,000 kg/ha (相當於施 SiO_2 674 kg/ha)。

各試驗地施用鑛滓後之谷增收率與稻藁 Sio_2 含量之關係圖



以上可見凡 Slag 之肥效顯著者，藁中 SiO_2 含量概低。如以谷增收率5%畫一界線可見 Slag 施用後得5%以上之增收者，其稻藁矽酸含量都在 9%以下，反之藁中矽酸含量達 9%以上者施用 Slag 概無肥效。根據今泉氏報告，收穫期之水稻藁（全部莖葉）中 SiO_2 含量如在 10%以下施用 Slag 概有效果，尤以 4～6%時效果最爲顯著，上面結果可謂符合。

由表1可見各地施用 Slag 後藁中矽酸含量較對照區或石灰石粉區均有增高，惟其程度以臺北、桃園、羅東等矽酸含量元來就低之地區較爲明顯（約增高 1.0～2.5%）而屏東、嘉義等矽酸含量元來已高者則不甚明顯（僅 0.5%左右）。

藁中矽酸含量因氮肥之增施而略有降低趨勢。其程度亦以臺北、桃園、羅東等地較爲明顯而屏東、嘉義等地則否。

由以上事實可以推想屏東、嘉義、臺中、龜山等藁中 SiO_2 含量高者其土壤中有效態矽酸之供應亦甚豐富，故施用 Slag 後其 SiO_2 含有率不復增高，肥效更不明顯，反之臺北、桃園、羅東等藁中 SiO_2 含量低者土壤中有效態矽酸之供應亦低，故施用 Slag 後其含量增加較爲明顯，肥效亦著。

本試驗中各地栽植之水稻品種並不盡相同（如下表）故上述藁中矽酸含量之差異除了反映水田土壤有效態矽酸之供應能力外是否尚反映着品種特性尚需檢討。但無論如何藁中 SiO_2 含有率低者需要供給矽酸却爲事實。據今泉氏報告[3]，藁中 SiO_2 含量和土壤有效態矽酸之含量有甚密切關係而品種之影響似不重要。

本試驗中各地栽植之水稻品種

試驗地	品種	試驗地	品種
臺北（二重埔）	臺中 65 號	中壢	臺中 65 號
（本所）	臺中 65 號	新竹	新竹 56 號
桃園（東埔）	新竹 56 號	臺中	臺中 65 號
（中路）	臺中 65 號	嘉義	嘉南 8 號
龜山	新竹 56 號	屏東	高雄 68 號
羅東	臺南 3 號		

又各地栽植之水稻品種，一、二期作並無更換。由表一可見各地第一期作矽酸含量似較第二期作稍低，惟差異不大。

三、臺灣各地水田土壤可溶性矽酸之含量

水稻之矽酸供給來源旣以土壤爲主，其有效態矽酸含量之測定可爲了解各地水稻矽酸營養情形之主要依據。

今泉氏[3]曾以日本栃木、長野兩縣水田土壤爲對象研究土壤中可溶性矽酸含量，藁中 SiO_2 含量與 Slag 肥效之關係，認爲 pH 4.0 IN NaAC Buffer 所浸出者最能代表土壤中之有效態矽酸並定 10 mg SiO_2/100g Soil 爲其缺否判定之界限。但亦有其他研究者[7][8]認爲該法不能適用而分別提出其他方法。

今以上述 Buffer 及 $\frac{N}{5}$HCl 分別測定全省各主要水田土壤樣品中各種可溶性矽酸含量得到土壤類別間一個籠統概念如下：

表十四　本省各地水田土壤可溶性矽酸之含量

Soil location	pH	可溶性矽酸含量 (mg/100 g)		備註
		pH 4.0 NaAC Buffer	$\frac{N}{5}$HCl	
a 紅壤				
桃園（東埔）*	4.9	6.6	90	
桃園（中埔）	5.5	7.5	89	
桃園（中路）*	5.0	9.3	93	
內壢	5.1	5.4	83	
中壢（農校）	4.7	4.3	72	
中壢（頂石頭）	4.9	6.8	89	
埔心站西	5.3	6.0	74	
埔心站北	5.1	3.1	41	
楊梅	—	8.2	45	
山崎	4.6	2.7	40	
新豐	4.9	1.7	23	S. L.
龜山*	5.7	4.1	38	S. L.
紅壤平均	4.6～5.7	5.5	65	

b 粘板岩質冲積土（員林）

員林	7.8	12.7	182	
花壇	7.8	18.9	137	
花壇	7.9	16.8	222	
永靖（東寧村）	8.0	20.6	251	
永靖（同安村）	8.0	14.5	217	
永靖（新莊村）	8.2	20.9	242	
永靖	7.2	22.1	224	
二水（惠民村）	7.9	16.3	145	
竹塘	7.6	13.3	194	
員林粘板岩質土壤平均	7.2〜8.0	17.3	202	

粘板岩質冲積土（宜蘭）

冬山香和*	5.5	3.6	296	
冬山香和	5.7	2.2	290	
冬山	7.2	4.5	320	
冬山（廣興）	5.4	3.8	121	
五結	5.2	1.6	76	
宜蘭	5.2	2.9	87	
平均	5.2〜5.7	3.1	198	
礁溪	4.5	2.0	68	
頭城	4.3	2.0	86	S. L.

粘板岩質冲積土（屏東）

麟洛*	5.1	4.0	108	
麟洛	6.9	34.0	177	
海豐	7.5	6.0	102	

c 北部砂岩頁岩質冲積土

臺北（公館）*	5.5	2.1	53	
臺北（公館）	4.8	2.6	55	
臺北（公館）	4.3	4.8	86	
臺北（景美）	4.8	1.9	50	
二重埔*	5.2	5.7	157	
新莊	6.5	5.6	105	
五股——成仔寮	5.3	4.0	134	
樹林	4.5	2.2	78	
大溪——鶯歌間	5.2	9.0	84	
大溪（仁善里）	5.2	5.9	70	
竹北（豆仔埔）	5.0	3.5	108	
竹北（豆仔埔）	6.5	6.2	102	
竹北（舊港）	6.5	4.7	114	
新竹（頂埔）	6.4	7.4	88	

新竹(湳雅)*	6.3	8.4	119	
臺中市(改良場)*	5.7	2.2	67	
臺中(西屯)	4.9	3.9	76	
臺中(西屯)	4.9	5.2	57	
臺中(北屯)	5.4	4.1	74	
臺中(神岡)	5.5	2.6	76	
北部砂岩頁岩質冲積土平均	4.8〜6.5	4.6	82.6	
d 其他				
臺中(龍井)	5.7	5.6	165	
彰化	5.8	10.2	172	
彰化	5.9	6.0	146	
嘉義(改良場分場)*	6.0	12.7	186	
義竹	8.0	19.7	162	鹽鹼土
花蓮吉安	7.6	6.4	304	片岩質冲積土
花蓮吉安	6.0	3.8	113	片岩質冲積土

* 印者爲田間試驗地土壤。S. L.爲Sandy Loam

由上表可見紅壤及北部之酸性砂岩頁岩質冲積土可溶性矽酸含量很低，而員林之粘板岩質冲積土及鹽鹼土則高。前者之醋酸鈉緩衝液及 $\frac{N}{5}$ HCl 可溶性矽酸含量各爲 10 mg 及 100 mg/100 g Soil 以下而後者則各爲 10 mg 及 150 mg/100 g Soil 以上。宜蘭之粘板岩質冲積土，花蓮之片岩質冲積土等醋酸鈉緩衝液可溶性矽酸含量雖低，但 $\frac{N}{5}$ HCl 可溶矽酸量却很高。一般看來，土壤 pH 値之高低與上述可溶性矽酸含量有關，pH 値高者其可溶性矽酸含量概高，反之則低。南部之砂岩頁岩質冲積土由此推測其可溶性矽酸含量當高。又 texture 粗之砂質土壤其可溶性矽酸含量一般亦較粘質土壤爲低。

就表13各試驗地稻藁 SiO_2 含量及 Slag 肥效之資料與各土壤中可溶性矽酸含量對照，其間雖無明顯相關，但大體觀之，上述田間試驗結果中臺北和桃園各試驗地稻藁矽酸含量特低以及 Slag 之肥效較爲顯著之事實，却和土壤測定所示紅壤及酸性砂岩頁岩質冲積土(尤其是pH 値低者)兩種可溶性矽酸含量皆低之結果符合。

摘要及結論

1. 盆栽試驗顯示施用鑛滓或膠狀矽酸後一穗重及一枝藁稈平均重量均增，因而其谷藁收量亦獲增加。

2. 田間試驗結果表示鑛滓在桃園、臺北及冬山肥效顯著惟其餘各地則否。其稻谷增收程度據桃園、臺北兩地各3年間6期作之試驗結果平均(在氮肥一般施肥量之下)爲9和10%。因石灰石粉效果甚小，該肥效當歸以矽酸爲主要因素。

3. 各地鑛滓肥效之有否和藁中 SiO_2 含量之高低有關。肥效顯著者其稻藁矽酸含量概低(如臺北、桃園、羅東均低爲5.5〜9.0%)反之則高。(如屏東、嘉義、臺中各試驗地均高，爲9.5〜13.5%)。以收穫時之稻藁爲準 SiO_2 9〜10%可爲判定 Slag 有否肥效之界線。

4. 土壤測定結果知酸性之砂岩頁岩質冲積土及紅壤可溶性矽酸含量很低而 pH 値較高之粘板岩質冲積土，南部之砂岩頁岩質冲積土以及鹽鹼土則含量甚高。Slag 之肥效亦於酸性之砂岩頁岩質冲積土及紅壤較有希望。

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STUDY ON THE EFFECT OF SILICA ON PADDY RICE (Part II)

by

S. LIAN

SUMMARY

Numerous literature on the nutritive value of silica to paddy rice was published in Japan. Its favorable effect on rice yield was widely confirmed, especially on the degraded paddy soil and the regions where soil is deficient in available silica or the silica content of irrigation water is low.

In this study, the evaluation of its applicability to our paddies has been investigated in rescent years. Both pot and field experiments were employed.

The results showed that there were certain experimental localities showing response of paddy yield to the application of silicic slag, however there were also others on which no response was observed. The soils of those experimental localities on which the effect of silica was observed are the acid sandstone and shale alluvial soil of Taipei, the latosol of Taoyuane and the ill-drained paddy soil in Illan. The increase of paddy yield caused by the application was 9% on an average. The effect was particularly significant when rice blast disease occurred.

The silica content (in SiO_2) of the straw at harvesting time varied from 5% to 14% among different locaties, which reflected possible difference of silica supplying power among the varied kinds of soil. In general, the SiO_2 content of the straw obtained from those localities on which silica was proved effective are apparently low (5.5–9.0%) as compared with that obeained from other experimental localities (9.5–14.0%) The SiO_2 content of straw and the response of paddy to silica application are apparently correlated.

The content of soluble silica in acid sandstone & shale alluvial soil and latosol was found very low as compared with that in slate alluvial soil, saline soil and mudstone alluvial soil. The content of soluble silica and the soil reaction seemed to be connected.

STUDIES ON THE PHYSIOLOGIC RACES OF *PIRICULARIA ORYZAE* CAV. (II)

by

C. C. CHIEN, S. Y. LIN and S. C. JONG*

The rice blast caused by *Piricularia oryzae* Cav. is one of the most important rice diseases in Taiwan. Hashioka (1950) studying the "mechanism of prevalence" of the disease in the tropics, recognized two major epidemiological types: the temperate-subtemperate and the subtropical-tropical. An epidemic occurrence of the temperate-subtemperate type is determined chiefly by factors related to the growth of the parasite, whereas that of the subtropical-tropical type, chiefly by those related to the resistance of the host. Accordingly, for controlling blast disease in the subtropical and tropical regions emphasis should be laid on the increase of host resistance.

Pathogenic and cultural specialization in rice blast fungus has been studied by several workers. Sasakii (1922–1923) reported three strains of the blast fungus, one being highly virulent and the others less so. Nozu (1928) identified a fourth strain of the fungus. Tochinai and Shimamura (1932) compared 41 cultures of *P. oryzae* and classified them into 9 distinct cultural types. Konishi (1935) studied possible correlation between cultural type and pathogenicity of the fungus, but drew no conclusion. Aoki (1935) described 14 types of *P. oryzae* according to their cultural characteristics. Abe (1936) found marked differences in virulence among strains of the fungus. Inoue (1930) classified isolates into strains on the basis of their ability to decompose cellulose. Comparing the virulence of the fungus by inoculation to leaf and ear of rice, Hemmi (1940) defined 11 strains. Since 1952, Suzuki (1953) has analyzed a large number of single-spore isolates of the blast fungus in an attempt to differentiate them, and established 12 homokaryotic types with respect to ways of spore germination, the ability to form appressoria at different temperatures, etc.. Goto et al. (1960) recently identified races of *P. oryzae* in Japan on the basis of their pathogenicity to selected rice varieties. In America, Latterel et al. (1954) reported the existence of at least two races of *P. oryzae*. In further studies, these authors found fifteen physiologic races characterized by disease reactions in ten rice varieties (Latterell et al., 1960). In 1962, Atkins reported the prevalence and distribution of fifteen pathogenic races of *P. oryzae* in the United States.

Field evidence indicating possible existence of physiologic races in Taiwan

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was first obtained by Li (1957) who observed difference in varietal reaction in blast nurseries established at four locations in 1956. This observation stimulated much research activities on this problem. The study on physiologic races of the blast fungus started in Taiwan Agricultural Research Institute in 1957, and in Academia Sinica, 1960. Hung et al. (1961) employing 16 differential rice varieties recognized five pathologic types among the seven isolates tested. The same group of differential varieties was used in the present studies with 67 isolates collected in 1960, 141 isolates in 1961 and 146 in 1962. Results to be presented here provide a further proof of the existence of physiologic races of *P. oryzae* in this island. The distribution and relative prevalence of the races are also described.

Materials and Methods

Cultures: A total of 354 isolates of *P. oryzae* was obtained from 95 varieties or selections of rice grown in the uniform blast nurseries established in five localities, namely, Ilan, Tungshu, Chiayi, Pingtung and Taitung. The usual tissue plating method was used for obtaining the pure cultures. All cultures were maintained on 2 per cent rice-polish agar slant. Before testing for pathogenicity, the original isolates were subjected to single-spore isolation using the Lambert's cylinder loop needle (Lambert, 1939). A dilute spore suspension was dispersed over the surface of 2 per cent agar plate. After incubating at 28°C for at least 5 hours, the germinating single-spores were cut out and transplanted individually to yeast-starch medium in a vessel (Misato et al., 1961). Spores were usually produced in sufficient numbers in 14 to 18 days for use in plant inoculation.

Differential Varieties: Sixteen varieties of rice used as differentials (Table 1) were selected by the late H. C. Li (1957). These are represented by 11 varieties of *Japonica* type and five varieties of *Indica* type. Of the *Japonica* type, one is from mainland of China, three from Japan and seven locally bred varieties. Of the *Indica* type, two are the upland rice and three the lowland rice.

Table 1. Sixteen rice varieties employed as differentials for identification of physiologic races of *Piricularia oryzae*.

Variety	Type	Origin
Kung-shan-wu-shen-ken	Japonica, lowland	Mainland, China
Taichung 65	Japonica, lowland	Taiwan
Pai-kan-tao	Japonica, lowland	Taiwan
Taichung 171	Japonica, lowland	Taiwan
Chianung 242	Japonica, lowland	Taiwan
Kwang-fu 1	Japonica, lowland	Taiwan
Chianung-yu 280	Japonica, lowland	Taiwan
Taichung line 33	Japonica, lowland	Taiwan

Kanto 51	Japonica, lowland	Japan
Norin 21	Japonica, lowland	Japan
Sensho	Japonica, lowland	Japan
Cutsugulcul	Indica, upland	Taiwan
Natala	Indica, upland	Taiwan
Kao-chio-liu-chou	Indica, lowland	Taiwan
Kaohsiung-ta-li-chen-yu	Indica, lowland	Taiwan
Taichung-ti-chio-wu-chien	Indica, lowland	Taiwan

Growth and inoculation of test plants: Inoculations were made in the green house on 16 differential rice varieties growing separately in an iron flat (30 cm× 30 cm×7.5 cm). Prior to inoculation, 2% ammonium sulfate solution was top-dressed to the flats twice, at the rate of 25 ml per flat for each application. Two weeks after planting (3–5 leaf stage) the seedlings were inoculated by spraying over leaves with spore suspension which contained 10 to 20 millions of fresh conidia in 100 ml distilled water. Check flats were sprayed with distilled water. Each flat was then kept under plastic sheet on a wooden frame for 20 hours (Anderson 1947). Reading of the disease reactions was made 4 to 9 days after inoculation, depending on the environmental conditions.

Grouping of Infection Types: According to Abumiya (1959), four major infection types of blast disease on rice plants can be recognized on the basis of lesion development and its final appearance.

R type (Resistant): (w)-(p)-b-yb.

M type (Moderately resistant): (w)-(p)-(pg)-bg.

S type (Susceptible): w-p-pg-ybg.

O type: Absence of lesion response.

The symbol ( ) indicates short duration of the described reaction. These systems for grouping infection types were adopted in the present studies except

Table 2. Systems for grouping blast infection types in the present experiment as compared to those adopted elsewhere.

Publisher	Year	Designation							
Hashioka	1950	E	D	C	B		A		
Takahashi	1951	0	1	2	3	5, 6	4		
Abumiya	1953	0	b	yb	bg	ybg	pg	p	w
Abumiya	1959	O	R		M	S			
Goto et al.	1960	HR	R		RS	HS	S		
Latterel et al.	1960	0	1	2	3	4	5		
The present Authors		R			M	S			

that the absence of lesion response was also recorded as R reaction. Somewhat different scales of infection types were proposed by Hashioka (1950), Latterel et al. (1960), Takahashi (1951), and Goto et al. (1960). A comparison of our system with those proposed by others for grouping infection types is given in Table 2.

Experimental Results

Sporulation: Conidia were needed in quantity for use as inocula in pathogenicity tests. It is therefore very important to study the sporulation of the fungus. The sporulability was found to differ with isolates and culture media used. With most isolates, about 60-80$\times 10^5$ spores per culture tube were produced on yeast starch agar slant (Yeast extract, 2 g; soluble starch, 10 g; agar, 16 g; water 1,000 ml). Some isolates, however, failed to produce large number of spores on the same medium. Of about 200 isolates tested, 50 yielded more than 5$\times 10^5$ spores per tube, 20 formed fewer than 10$\times 10^4$, and the rest produced about 9$\times 10^5$ spores per tube. Several natural media, e.g., broad-been agar, kindney-bean agar, string-

Table 3. Sporulation of five isolates of *P. oryzae* on different media (pH 5) after two weeks of incubation at 28°C.

Isolate	Medium					
	Yeast-starch agar		Rice-polish agar		Rcie-straw agar	
	Amount*	r**	Amount	r	Amount	r
1Ta-5R	3.00	1.65	2.80	1.63	2.90	1.65
1C-14R	1.40	1.14	0.50	0.70	0.50	0.70
0S-45S	173.40	12.78	28.90	5.33	1.30	3.53
1I-31N	28.60	5.28	2.40	1.47	2.90	1.62
1Ta-5S	134.60	11.19	14.10	3.59	17.30	4.03
L. S. D. 5%		1.701		0.424		0.456
L. S. D. 1%		2.282		0.569		0.612

Isolate	Medium				L. S. D. 5%	L. S. D. 1%
	Rice-seedling agar		String-bean agar			
	Amount	r	Amount	r		
1Ta-5R	1.00	1.00	3.50	1.78	0.233	0.310
1C-14R	0.50	0.70	0.50	0.70	0.339	0.454
0S-45S	6.30	2.42	14.40	3.67	0.745	0.999
1I-31N	16.10	3.97	17.40	4.04	0.570	0.765
1Ta-5S	4.30	1.95	10.60	3.17	1.218	1.634
L. S. D. 5%		0.391		0.582		
L. S. D. 1%		0.525		0.781		

* Average number of spores per 1/30,000 ml.

** Square root of the average number of spores.

bean agar, onion agar, Tochinai-Nakano agar, rice-polish agar, rice-straw agar, etc., also allowed abundant conidial production. With some isolates, these proved to be better media than the yeast starch agar. On corn-meal agar and Czapek's agar very few spores were formed. Table 3 showed the sporulability of several isolates on five different media. Isolates also varied in the length of cultivation that effected spore formation. Most isolates produced considerable amount of spores after one week of incubation at 25–31°C, but a few failed to do so. This is particularly true when yeast starch medium was used. Isolate 0C-5N, for example, produced very few spores after 14 days of cultivation on yeast-starch agar slant at 27–28°C but yielded abundantly after 3 weeks. This phenomenon was not observed with rice-polish agar, however. According to Anderson and Henry (1948), the time required for maximum sporulation may differ with isolates, and with the way in which the cultures are handled. In our results the maximum sporulation was usually obtained after 14 days on yeast-starch agar slant at 27°C by mass mycelial transfer; 4–7 days in vessel containing 40 ml of yeast-starch agar seeded with spore suspension; or 9–12 days in the aerated flask containing autoclaved rice grains. Amount of spores in inoculum was found to be an important factor affecting sporulation, the incubation period required for the maximum production of spores was shortened by using heavier inoculum.

Identification of Races: The 354 isolates tested during 1960–1962 were identified as to belong to 19 physiologic races. Varietal reactions to these races are shown in Table 4. These races can be conveniently distinguished into seven race groups as follows:

Group A: Isolates of this group containing one single race (Race 1) were either avirulent or weakly pathogenic to the 16 differential varieties. No lesions or only resistant lesions were produced under the experimental conditions. Apparently, some isolates of this group might have lost their pathogenicity upon culturing, as evidenced from the fact that they originated from one of the differential varieties and were obtained from susceptible leaf lesions.

Group K: Isolates that constituted this monoracial (Race 2) group caused susceptible leaf lesions only on the variety Kung-shan-wu-shen-ken. No infection or resistant leaf lesions were induced on other varieties. This race group also contained isolates that were obtained from susceptible lesions on differential varieties other than Kung-shan-wu-shen-ken, a fact suggesting the loss of pathogenicity during cultivating.

Group N: This group was represented only by a few isolates of race 3 causing susceptible lesions on the *indica* variety Natala but resistant lesions on other differential varieties. One isolate of this group originally from a susceptible lesion on Taichung 65 failed to induce susceptible reaction on this same variety upon testing.

Table 4. Physiologic races of *P. oryzae* identified in Taiwan during 1960–1962.

Differential variety	Race designation										
	A	K	N	J				I			
	1	2	3	4	5	6	7	8	9	10	11
KSWSK	R	S	R	S	S	S	S	R	R	R	R
TC 65	R	R	R	R	S(m)*	S	R	R	R	R	R
PKT	R	R	R	R	M(r)	S	R	R	R(s)	R	S
TC 171	R	R	R	R	R	R	R	R	R	R	R
CN 242 / KF 1	R	R	R	R	R	S	R	S	R	R	R
CNY 280 / TCL 33	R	R	R	R	R	R	R	R	R	R	R
KT 51	R	R	R	S	M	S	S	R	R	R	R
NR 21	R	R	R	S	M	S	S	S	R	R	R
SS	R	R	R	S	M	S	S	S	R	S	S
Cuts.	R	R	R	S(m)	S	S	S	R	R	R	S
Nat.	R	R	S	S	S	S	S	S(m)	S	S	R
KSLC	R	R	R	R	S(m)	S	S(m)	S	S(r)	S	S
KH-TLCY	R	R	R	R	M	S	S(m)	S	S	S	S
TC-TCWC	R	R	R	S(m)	R	S(m)	S(m)	S	S	S	S

Differential variety	Race designation							
	P					X		
	12	13	14	15	16	17	18	19
KSWSK	S	S	S	S	S	S	S	S
TC 65	S	S	S	S	S	S	S	S
PKT	S	S	S(m)	S(r)	S	R	S	R
TC 171	S	S	S	S	S	R	R	S
CN 242 / KF 1	S	S	S	S	S	R	R	S
CNY 280 / TCL 33	S	S	S	S	S	R	R	R
KT 51	S	R	S(r)	R	S	R	R	S
NR 21	S	R	S	R	S	R	R	R
SS	S	R	S(m)	M	S	R	R	R
Cuts.	S(m)	S	S(r)	R	S	R	R	R
Nat.	S(m)	S(m)	S	S	S	R	S(m)	S(m)
KSLC	S	S	S	R	R	R	R	R
KH-TLCY	S	S	S(r)	R	R	R	R	R
TC-TCWC	S	S	M	R	R	R	S	R

* The small letters in parentheses denote the minor infection types observed in the inoculated plants.

Group J: Isolates of four races (4, 5, 6 and 7) that constituted this group produced susceptible leaf lesions on Kung-shan-wu-shen-ken as well as on the two upland *indica* varieties. Lesions of susceptible or intermediate types were induced on the three *japonica* varieties. The four races, however, differed in their reactions on other differential varieties.

Group I: This race group was also composed of four races (8, 9, 10 and 11) which produced susceptible leaf lesions on the three local varieties of lowland *indica* rice, but, resistant reaction on Kung-shan-wu-shen-ken. All or most of the locally developed *japonica* rice varieties responded with resistant reaction.

Group P: Five races (12, 13, 14, 15 and 16) were taken under this group for the susceptible type lesions on Kung-shan-wu-shen-ken and on the seven locally developed *japonica* varieties. The variety Natala from which Taichung line 33 derived its blast resistance also gave susceptible response to these five races. Race 12 of this group was the most virulent one among the 19 races so far recognized. It produced susceptible leaf lesions on all 16 differential varieties.

Group X: This was apparently a highly heterogeneous race group composing of three races (17, 18 and 19) which had few pathogenic properties in common. Susceptible reaction was produced by isolates of the three races on Kung-shan-wu-shen-ken and Taichung 65.

Different races were observed among cultures derived originally from one single-spore isolate. It is not known whether this was due to mutation or intermingling of genetically different nuclei in vegetative hyphae within a heterokaryotic system of the fungus (Suzuki 1962).

Prevalence and Geographical Distribution of Races: The geographical distribution pattern of 19 races of *P. oryzae* identified in Taiwan during 1960–1962 is shown in Table 5.

Races 1, 2, 7, 10, 12, 13, 14, 17 and 18 were obtained from all five areas where blast nurseries were located and collections of the fungus made. Of these races, 13 and 17 seemed to be the most predominant, being isolated over 40 times within the three year period. Races 3, 8, 11 and 19 were found in fewer than four times and confined to two or three localities. Of the 7 race groups, group P could be considered as the most prevalent and widely spread. Races of this group were isolated 121 times and found in all five localities.

The 19 races identfied did not all appear each year during the three year period. The actual number of races detected was 13 in 1960; 12 in 1961; and 17 in 1962. In consideration of locality, 13 races were found in Taitung area; 17 in Pingtung; 15 in Ilan; 14 in Tungshu; 13 in Chiayi. The distribution of the major races in the five areas was as follows: Ilan, races 13 and 17; Tungshu, races 9, 10, 12 and 13; Chiayi, races 12 and 13; Pingtung, races 10, 13, 14, and 17; Taitung, races 12 and 17.

Table 5. Geographical distribution of physiologic races of *P. oryzae* isolated in Taiwan during 1960–1962.

Source	Year	Number of isolates: Group A	K	N	J				I			
		Race 1	2	3	4	5	6	7	8	9	10	11
Ilan	1960	1	1									
	1961	2	1		4						1	
	1962	10	2	1			2	2		2		1
Tungshu	1960	3	1		2				2	3	2	
	1961	1	1		2					9	5	
	1962				1		1	1		2	1	
Chiayi	1960										2	
	1961	3	1									
	1962	4	6		2	1		1			1	
Pingtung	1960			1								
	1961	3	1							2	5	
	1962	6	6	1		3	1	2			4	2
Taitung	1960								2			
	1961	1	5							2	2	
	1962	3	2	1	3	2	1	1				
Number of isolates	1960	4	2	1	2	0	0	0	4	3	4	0
	1961	10	9	0	6	0	0	0	0	13	13	0
	1962	23	16	3	6	6	5	7	0	4	6	3
Total		37	27	4	14	6	5	7	4	20	23	3

Source	Year	Number of isolates: Group P					X			Total	Number of races	
		Race 12	13	14	15	16	17	18	19			
Ilan	1960	1	1	2			1		1	8	7	
	1961		2	12			1	1		24 } 57	8	15
	1962		1				1	3		25	10	
Tungshu	1960	4	11		1		1			30	10	
	1961	3	6	5			1	7		40 } 80	10	14
	1962	1	1					2		10	8	
Chiayi	1960	2	3	1	1					9	5	
	1961	2	8	3			3	1		21 } 68	7	13
	1962	2	6		1	6	3	5		38	12	
Pingtung	1960	2			3					6	3	
	1961	1	4	1	4		3		2	26 } 71	10	17
	1962		1	2		1	8	2		39	13	
Taitung	1960	2			1		8		1	14	5	
	1961	1	6	2			9	2		30 } 78	9	18
	1962	4		2	4	4	5	2		34	13	
Number of isolates	1960	11	15	3	6	0	10	0	2	67	13	
	1961	7	26	23	4	0	17	11	2	141	12	
	1962	7	9	4	5	11	17	13	0	146	17	
Total		25	50	30	15	11	44	24	4	354	19	

Cultural Characteristics: On yeast-starch medium, six distinct cultural types were discerned among the isolates tested.

Type A: White colony with aerial mycelial growth 1 mm in height, and sparse conidial formation.

Type B: Colony greyish white with aerial mycelial growth 1 mm in height, and sparse conidial formation.

Type C: Colony greyish in color with dark concentric rings, aerial mycelium 2 mm high. Later white tufty oppressed mycelium appearing on the surface. Spores abundant.

Type D: Colony greyish in color with aerial mycelial growth 2 mm in height, and rather profuse sporulation.

Type E: Colony with white coarse aerial mycelial growth 3–4 mm in height and profuse sporulation.

Type F: Colony slightly brownish with mycelial growth 1 mm in height, Sporulation varied from sparse to abundant.

Cultural types of blast fungus were to some extent associated with pathogenicity. However, there was no definite correlation between cultural characters and pathogenic races. Sometimes isolates of different cultural types were pathogenically alike; and sometimes isolates of same cultural type produced different plant reactions in the differentials. Cultures of *Piricularia* sp. isolated from *Panicum repen* (Grass) showed different cultural characteristics from *P. oryzae.* Slower growth was the most conspicious one. Isolates of cultural types C, D and E usually had a strong pathogenicity, while types A and B were weakly pathogenic. Isolates of type F varied from being weak to strong.

Cross-infectivity Tests with P. oryzae and P. sp.: Isolates of *Piricularia oryzae* from rice and *P. sp.* from *Panicum repen* were used to inoculate each other's host. No infection was obtained either on rice by isolates from *P. repen* or on *P. repen* by isolates from rice.

Summary

A total of 354 cultures of *P. oryzae* isolated from 95 varieties or selections of rice grown in five localities of Taiwan were grouped into 6 distinct cultural types according to their cultural characteristics on yeast-starch agar. Using 16 rice varieties as differentials, these isolates were identified as to compose 19 physiologic races which could further be conveniently distinguished into seven race groups on the basis of their ability to attack the differentials. The distribution of the major races in the five areas is as follows: Ilan, Races 13 and 17; Tunshu, Races 9, 10, 12 and 13; Chiayi, races 12 and 13; Pingtung, races 10, 13, 14 and 17; Taitung, races 12 and 17. Of the 7 groups, group P could be considered as the most prevalent and widely spread.

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稻熱病病原菌生理型之研究 (II)

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摘　　要

1. 從1959年起，自全省稻熱病測定試驗病圃（宜蘭、東勢、嘉義、屏東、臺東等地）及臺北、桃園、新竹、臺中、臺南、高雄等地區採集稻熱病病害標本。經人工純系單胞分離後，在酵母培養基上鑑別其培養型，並於溫室內舉行人工接種在十六鑑別稻品種上，以測定各菌株之感病反應。

2. 純系分離之稻熱病病原菌，在酵母培養基上，可分爲6種培養型，以 A, B, C, D, E 及 F 等表之。C, D, E 三型常具强之病原性；A, B 兩型之病原性較弱；F 型之病原性不定。

3. 354 個純系分離之稻熱病病原菌，接種於鑑別稻種上，得到19種不同之生理小種，以 1, 2, 3～19 等表示之。並以品種間感病反應之差異，可組成爲 7 個小種羣。

4. 19 生理小種中，1960 年發現 13 小種；1961 年 12 小種；1962 年 17 小種。宜蘭臺北區共 15 種生理小種，以 13 及 17 最多；臺中東勢區共 14 種生理小種，以 9, 10 及 13 最多；嘉義地區共 13 種生理小種，以 12 及 13 最多；屏東地區共 17 種生理小種，以 10, 13, 14 及 17 最多；臺東地區共 18 種生理小種，以 12 及 17 最多。

RESIDUAL TOXICITY OF SOME INSECTICIDES AGAINST THE NEWLY HATCHED LARVAE OF THE PADDY BORER, *SCHOENOBIUS INCERTULAS*

By

SUNG-YANG LEE & WEN-YAU HONG

Tests conducted on the second paddy crop in Taipei in 1961 (Lee, 1961) showed that Sumithion gave excellent initial effect against the larvae of the paddy borer, *Schoenobius incertulas* Wlk., but was effective residually only for about one week. In the present tests persistence of Sumithion at a higher insecticide concentration and in combination with endrin was compared with parathion, EPN, and endrin. A brief discussion was made on the mode of action of residues of endrin and parathion on the newly hatched larvae. Trials were also conducted on the residual effect of these compounds when applied in a soil. Two field tests were carried out at Chiayi and Taipei to study residual control of the pest.

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MATERIALS AND GENERAL PROCEDURE OF RESIDUAL EFFECT TESTS.—The insecticides used in these tests were all in the form of emulsifiable concentrate; their active ingredients being as follows: Sumithion, 50%; parathion, 47%; EPN, 45%; endrin, 19.5%. The paddy plants used were variety Taichung No. 65, planted in pots, unless otherwise stated. The test larvae were those just emerged from the egg-clusters collected from paddy fields in Tainan and Chiayi districts. Sprays were applied with a hand sprayer (mosquito gun). Number of the test larvae released was 10 to 20 per hill of the plant unless otherwise mentioned. A counting of the withering tips or the ears caused by the larvae was made 4 days after releasing the larvae.

RESIDUAL EFFECT ON THE PLANT JUST BEFORE THE HEAD-FORMING STAGE OF THE FIRST CROP.—The plants were 60 days of age after transplanting when sprayed. No tiller came into the ear during the period of the test. Emulsions were applied at the rate of 17 cc. per hill, equivalent to 3,400 liters per hectare. The maximum temperatures during the test period ranged from 34 to 37°C. The results were given in table 1, which indicate that when 0.1 per cent concentration was used, Sumithion appeared to be somewhat superior residually to 0.05 per cent concentration, and that considerably better residual effect was obtained when it was combined with endrin. It does not seem necessary to use high concentrations when the two compounds are to be mixed, that is, 0.05 and 0.02 per cent appear to be adequate for Sumithion and endrin respectively. EPN at a higher concentration also showed promising residual effect. Endrin and parathion gave rather poor

residual effect in this test.

RESIDUAL EFFECT ON THE 30-DAY-OLD PLANTS OF THE SECOND CROP AND MODE OF ACTION OF RESIDUES OF PARATHION AND ENDRIN ON THE LARVAE.—The plants used in this test were planted directly in the paddy field, 30-day-old after transplanting when sprayed. The plants were caught b a typhoon on the 9th day after spraying. The maximum temperatures varied from 23 to 34°C.

Table 1. Residual effect of some insecticides for preventing the newly hatched paddy borer larvae from damaging the first paddy crop just before the head-forming stage. Sprayed on June 9, 1961. Taipei.
(1 to 2 hills examined in each treatment)

Treatment and Concentration (%) (17 cc/hill)		No. Of Tillers Whose Tips Withered/Total Examined (Larvae released at indicated days after spraying)					
		3	5	6.5	8	11	13
Untreated		3/110	8/75	8/49	11/65	11/38	7/27
Sumithion	0.1	0/82	1/76	1/44	2/44	4/36	2/44
	0.04	1/82	1/73	0/34	4/46	6/38	4/34
Sumithion Plus Endrin	0.1 0.04	1/85	0/74	0/28	1/41	9/44	1/35
Sumithion Plus Endrin	0.05 0.04	0/87	1/71	0/41	1/49	0/40	1/32
Sumithion Plus Endrin	0.1 0.02	0/95	0/79	0/45	2/45	5/53	0/43
Sumithion Plus Endrin	0.05 0.02	0/75	0/80	0/36	0/35	0/41	1/36
Endrin	0.04	1/98	1/48	1/41	5/48	11/48	2/36
	0.02	5/72	0/80	5/40	3/40	1/24	3/39
Parathion	0.05	4/81	0/76	0/35	3/39	2/31	2/32
	0.025	0/88	0/69	3/41	3/43	4/38	5/35
EPN	0.05	0/77	1/77	0/34	0/35	4/41	1/33
	0.025	1/91	0/81	2/39	7/50	3/45	4/46

during the test period. Table 2 summarizes the results. These data also suggest that Sumithion plus endrin may be residually better than Sumithion alone at 0.1 per cent concentration. Although some residual effect was still found in several treatments 11 days after spraying in the previous test, in this test little residual activity was observed in all the treatments. This may be owing to a lower dosage used or to the typhoon that occurred 9 days after spraying. When paddy plants are caught in a typhoon, the outer leaf sheaths will come off the stems or the straws, providing the invading newly hatched larvae with readier entrance into the interior part of the plants. It is worthy to discuss here the habit of the boring of the newly hatched paddy borer larvae into the the paddy plants and mechanisms by which the residues of insecticides may act on the larvae. As a rule, the majority of the larvae after hatching do not make an entrance hole on the outer surface of the plants, except on very young plants, but move here and there trying to find some openings on the plants through which they can readily crawl into some

Table 2. Residual effect of some insecticides for preventing the newly hatched paddy borer larvae from injuring the second paddy crop, 30-day-old after transplanting. Sprayed Sept. 2, 1961. Taipei. (1 to 5 hills examined per treatment)

Treatment and Concentration (%) (6 cc/hill)		No. Of Tillers Whose Tips Withered/Total Examined (Larvae released at indicated days after spraying)	
		6	11
Untreated		4/19	12/111
Sumithion	0.1	1/22	19/98
	0.5	2/18	13/94
Sumithion Plus Endrin	0.1 0.04	0/29	10/130
Sumithion Plus Endrin	0.05 0.04	1/25	14/116
Sumithion Plus Endrin	0.1 0.02	0/31	14/122
Sumithion Plus Endrin	0.05 0.02	1/25	17/119
Endrin	0.04	0/24	25/125
	0.02	0/28	16/108
Parathion	0.05	1/31	19/128
	0.025	2/20	26/129
EPN	0.05	0/19	22/129
	0.025	0/30	15/96

sheltered spot to bore an entrance hole into the plant tissue for feeding. It was found from the tests conducted in Sept. 1961 that the surface residues of endriu or parathion did not appear to play an important part in killing the newly hatched larvae. In this test, the test larvae were released 41 or 48 hours after spray. The paddy plants used in these tests were about 5 days before heading stage. Their loose outer leaf sheaths were removed from the plants before spraying to eliminate open entrance for the test larvae. Most of the larvae when released crawled on the plants up and down for a while, then tried to move away by spinning, but they were artificially returned on the plants and kept walking on the surfaces for about 30 to 60 minutes, then removed to untreated fresh plants for feeding. Mortality count of the treated larvae was made 24 hours after releasing on the untreated plants. The results of these tests were shown in table 3. The data suggest that uptake of the residues of endrin on the surface of the plants through the legs of the larvae, if any, may be negligible in acting upon the larvae (normally it takes about 5 to 25 minutes for the newly hatched larvae to complete boring an entrance hole on the surface of the plants and get inside when they decide to make it instead of trying to find an opening on the plants). But, surface residue of parathion soon after spraying seems to show some toxic effect on the invading larvae. High mortality of the larvae in the untreated check plants seems to indicate that

death of the insect on treated plants was caused by exhaustion. Further studies will be made to settle this problem.

Table 3. Fate of the newly hatched paddy borer larvae after kept walking on the surfaces of the paddy plants sprayed with endrin and parathion 5 days before the heading stage.

Treatment (0.05%)	Per Cent Mortality Of The Larvae 24 Hours After Treatment[a] (Test larvae released on the plants at indicated hours after spraying)	
	41	48
Untreated	27 (4/15)	44 (20/45)
Endrin	18 (4/22)	51 (19/37)
Parathion	56 (5/9)	46 (12/26)

[a] Number of the dead larvae and the total examined were given in parentheses.

On the other hand, in these trials, many larvae remained on plants, quite a few of them could crawl into the part behind the outermost leaf sheaths, and some of them bored into the ear, though the opening at the top of the leaf sheaths was very slight. The fate of these insects 48 hours after releasing was shown in table 4.

Table 4. Fate of the newly hatched paddy borer larvae released on the plants (5 days before the heading stage) 41 to 48 hours after being sprayed with endrin or parathion. (Under laboratory conditions. Examined 48 hours after releasing)

Treatment 0.05%	No. Of Dead(D), Live(L) or Moribund(M) Larvae Found In The Parts Of The Plants Indicated		
	ON THE OUTSIDE	IN BETWEEN LEAF SHEATHS[a]	INSIDE THE GLUME(G) OR LEAF SHEATH(L)
Untreated	D. 5	0	L. 20 in G.
Endrin	D. 4[b]	D. 22	D. 4 in G.; M. 2 on G.; L. 2 in G.
	D. 18[c]	D. 26	0
Parathion	D. 2	D. 11	D. 1 in L.; D. 3 on G.
	0	D. 28	D. 5 in L.

[a] The larvae forced their way into this part through very slight opening at the top of the leaf sheath.
[b] One entrance hole was made on the surface of the straw, and the larvae were killed around the hole. Mortality seemed to be due to stomach poisoning.
[c] All the dead larvae were found around the ligule of the outermost leaf.

It was found from the data of table 4 that the larvae killed in between the leaf sheaths in both treatments were those sqweezed their way into the plants through the top of the sheaths. The mortality might be due partly to contact poison resulted from getting in tight contact with the toxicants that were present in a larger amount in the part around the ligule, as no feeding scar was observed

in the area where the larvae were found dead. The death of the larvae found inside the glume or the leaf sheath might also be owing to such contact with the residues before they got inside the plants. Such contact with the toxicant, however, does not seem great under natural conditions, because normally the outer leaf sheaths are coming off the stems or straws due to various causes such as aging, damage by winds or certain pests. As stated before, the majority of the larvae on such plants quickly crawl inside; and bore an entrance hole on the surface of the inner leaf sheath that is enveloped by the outer leaf sheath, or mine into the tissue of the outer leaf sheath from the inside. In the latter case higher mortality would result from stomach poisoning, because the leaf sheath in which they feed is directly exposed to the spray. But, in the former case, whether or not stomach poisoning takes place seems to be depending on the amount of the residues (penetrated or translocated from the part that was exposed to the spray) present in the part they first feed on, or may depend on the parts toward which their subsequent feeding proceeds (directly into the central part of the straw or eat lengthwise in the same leaf sheath on which they made an entrance hole. Higher mortality may result in the latter case). The presence or the amount of the residues in such "sheltered-parts" of the tiller that may be first fed upon by the larvae will be affected by many factors, such as character of the insecticides used, especially their penetrating or systemic effect, degree of openings on the plants, physiological conditions of the plants, amount of spray applied, and method of application. At any rate, to see how the residues of endrin and parathion act on the newly hatched larvae under natural conditions a test was conducted using the plants several days before the heading stage. In this test, no adjustment was made on the plants, that is, the loose outer leaf sheaths were not removed, and slight to medium openings between the leaf sheaths were left as they were. Sprays (0.05%) were applied on Sept. 24th. Test larvae were released on the plants 3 days after spraying. It rained soon after releasing the insects. The larvae were examined 24 hours after releasing. The results were examined on 15 hills per treatment; and are summarized as follows: in endrin treated plants 42 larvae were recovered, of them one bored into the leaf sheath through an entrance hole it made on the outside, and was alive; 25 crawled inside the plant through the openings behind the outer leaf sheaths and feeding already took place, of which 11 were moribund and 14 alive; 16 appeared to have crawled inside the plants through the opening on the flag leaf sheath, and were in the axis of the ear, all alive; (mortality 26%). In parathion treated plants, 40 larvae were recovered, of which one made an entrance hole on the surface of the straw and was killed in the spot; 16 crawled in behind the leaf sheath through an opening in its top, and all dead, though no feeding scar was found; 18 similarly reached behind the leaf sheath through an opening and already fed the tissues, all killed; 5 were found on the ear inside the flag leaf sheath, of which 4 were dead and 1 alive; (mor-

tality 98%). It seems from these results and the data of table 4 that residual effect of endrin varies more greatly with conditions of the plants than parathion.

RESIDUAL EFFECT OF SOME CHEMICALS ON THE SECOND CROP AT THE HEADING STAGE.—Three tests were conducted. The plants used in test one were planted in pots, and those used in tests two and three were planted in paddy fields. In order to standardize the test plants as much as poosible the outer leaf sheaths that were coming off the straws or severely injured by leafhoppers or other pests were removed a day before spraying. Emulsions were applied with a hand sprayer at the rate of about 6 cc. per hill. In all the tests, shooting up of the heads started several days after spraying. Table 5 summarizes the results of these tests. The data show that no great difference in residual effect may be found on 6th or 7th day after spraying between different treatments except Sumithion when used alone, and that residual activity of these compounds became negligible after the plants were exposed in a typhoon. Residual effect also appears to be much poorer on the plants that came into the ear. This seems to be owing to the fact that when the ear is partly emerging, almost all the newly hatched larvae crawl into the lower part of the ear that is still enveloped by the flag leaf sheath and eat in the glumes or in the axis of the ears in which little or nonlethal amount of the toxicant is present.

It is found from the data so far obtained that when applied as a foliar spray, no chemical tested gave satisfactory residual effect 10 days after treatment, and much less residual effect is obtained on the plants at the heading stage or after they are caught in a typhoon. The possible causes for such poor residual effect have already been discussed. In addition to such inevitable difficulties in securing good residual effect on the paddy plants, there arises another difficulty of applying chemicals by a foliar spray in a way to obtain good coverage on every tiller in the hill with a pneumatic knapsack sprayer. Therefore, in order to procure better control of the pest, other methods of applying insecticides should be studied. With this view point, the following soil treatment trials were conducted.

SOIL TREATMENT TRIALS.—Two trials were made using Taichung No. 65 variety planted in pots. In both trials chemicals were applied on the surface of the soil surrounding the hill after drainage of irrigation water; then they were lightly plowed into the soil. Heading of the plants started several days after application of insecticides in both tests. About 60 newly hatched larvae were released per hill 13 days after treatments in trial one, and 14 days after in trial two. The results were examined 5 days after releasing the larvae and are given in tables 6 and 7. It is found from the data in table 6 that all chemicals were still quite effective 13 days after treatment. Lindane appeared to be much better than other chemicals. Data in table 7 show that residual effect of Sumithion, endrin, parathion, and EPN applied in the soil appears to vary considerably according to different conditions of the tillers and possibly to some other conditions. However,

Table 5. Residual effect of some insecticides for preventing the newly hatched paddy borer larvae from damaging the second paddy crop at the heading stage. Taipei. 1961. (1 to 5 hills examided per treatment)

Treatment and Concentration (%)	No. Of Tillers Injured/Total Examined (Larvae released at indicated days after spraying)					
	6	7	8	9	10	11
Test 1, sprayed on Sept. 1[a]. (Max. temp. 34°C.)						
Untreated	4/82	—	—	—	—	23/151
Sumithion 0.1	1/90	—	—	—	—	8/174
0.05	1/72	—	—	—	—	20/152
Sumithion 0.1 Plus Endrin 0.04	0/71	—	—	—	—	14/153
Sumitnion 0.05 Plus Endrin 0.04	0/76	—	—	—	—	18/166
Sumitnion 0.1 Plus Endrin 0.02	2/88	—	—	—	—	39/169
Sumitnion 0.05 Plus Endrin 0.02	0/74	—	—	—	—	32/146
Endrin 0.04	1/81	—	—	—	—	19/148
0.02	0/70	—	—	—	—	40/153
Parathion 0.05	0/68	—	—	—	—	36/161
0.025	1/91	—	—	—	—	14/160
EPN 0.05	0/83	—	—	—	—	22/153
0.025	0/73	—	—	—	—	28/156
Test 2, sprayed on Oct. 8. (Max. temp. 33°C.)						
Untreated	—	2/85	—	3/44	—	13/83
Sumitnion 0.1	—	1/75	—	0/36	—	5/73
0.05	—	3/72	—	0/38	—	6/69
Sumitnion 0.1 Plus Endrin 0.04	—	2/76	—	0/40	—	5/74
Sumithion 0.05 Plus Endrin 0.04	—	0/63	—	0/39	—	7/63
Sumithion 0.1 Plus Endrin 0.02	—	0/65	—	0/38	—	0/65
Sumithion 0.05 Plus Endrin 0.02	—	0/70	—	0/40	—	3/70
Endrin 0.04	—	0/66	—	0/36	—	7/66
0.02	—	0/70	—	0/36	—	4/70
Parathion 0.05	—	0/65	—	0/33	—	1/65
0.025	—	0/72	—	0/42	—	14/72
EPN 0.05	—	1/79	—	0/59	—	5/78
0.025	—	0/78	—	0/57	—	3/78
Test 3, sprayed on Oct. 12. (Variety Tainon No. 8) (Max. temp. 33°C.)						
Untreated	3/48	—	5/51	—	9/65	—
Sumithion 0.1	4/42	—	5/49	—	7/60	—
0.05	6/42	—	5/47	—	11/60	—
Sumithion 0.1 Plus Endrin 0.04	1/39	—	2/52	—	5/63	—
Sumithion 0.05 Plus Endrin 0.04	0/28	—	4/56	—	9/52	—
Sumithion 0.1 Plus Endrin 0.02	1/39	—	7/51	—	8/63	—
Sumithion 0.05 Plus Endrin 0.02	5/35	—	7/53	—	7/56	—
Endrin 0.04	2/42	—	5/47	—	12/63	—
0.02	3/42	—	1/46	—	9/64	—
Parathion 0.05	3/41	—	4/49	—	4/57	—
0.025	1/36	—	1/52	—	6/69	—
EPN 0.05	2/45	—	1/49	—	8/73	—
0.025	0/44	—	5/57	—	10/68	—

The plants were caught in a typhoon 10 days after spraying.

lindane does not seem to vary as great as other chemicals and again showed the best effect. The results of these trails show that the chemicals tested as a soil treatment appear to loose their effect quite soon except lindane dust at the dosages used. Further tests are needed on the effect of soil treatments.

Table 6. Residual effect of several insecticides applied in the soil for preventing newly hatched paddy borer larvae from damaging the paddy plants at the heading stage. Treated on Sept. 1, 1961. Taipei. (2 hills sxamined per treatment)

Compound and Concentration (%)	Dosage Per Hill	No. Of Tillers Damaged/Total Examined (Larvae released 13 days after treatment)	
Untreated		6/34	5/28
Sumitnion e.c. 0.05	30 cc	0/21	2/22
Endrin e.c. 0.05	30 cc	1/34	3/25
Endrin dust 3.0	5 g	1/22	2/37
Lindane dust 3.0	5 g	0/22	0/32

Table 7. Residual effect of some insecticides applied in the soil for preventing the newly hatched paddy borer larvae from damaging the paddy plants at the heading stage. Treated Oct. 12, 1961. (Larvae released 14 days after treatment; examined on 4 hills per treatment)

Compound and Concentration (%)	Dosage Per Hill	No. Of Tillers Infested With Living Larvae /Total Examined	No. Of Tillers Infested But The Larvae Killed /Total Examined
A, examined on effective tillers with ears.			
Untreated		10/70	4/70
Sumithion e.c. 0.05	30 cc.	20/80	8/80
Endrin e.c. 0.05	30 cc.	10/73	5/73
Parathion e.c. 0.05	30 cc.	20/79	3/79
EPN e.c. 0.05	30 cc.	25/65	6/65
Lindane dust 3.0	5 g.	3/90	14/90
B, examined on ineffective tillers.			
Untreated		2/6	2/6
Sumithion e.c. 0.05	30 cc.	2/12	5/12
Endrin e.c. 0.05	30 cc.	0/9	5/9
Parathion e.c. 0.05	30 cc.	4/25	9/25
EPN e.c. 0.05	30 cc.	0/17	8/17
Lindane dust 3.0	5 g.	0/16	2/16

FIELD TESTS.—Field tests were conducted on the second crops in Chiayi and Taipei. The paddy plants used for the test in Chiayi was variety Chianon No. 8, transplanted on July 11th. Sprays were applied on Sept. 11 at the rate of 1,200 1.

per hectare with a pneumatic knapsack sprayer at the pressure of about 40 p. s. i. The treatments were randomized and replicated four times. Each test plot was about 0.005 are in area containing 1,000 hills of the plants. The plants were caught in a typhoon about 12 hours after spraying. Heading started several days after treatment. The results were examined on Sept. 30th by counting the number of the white ears. The plants used for the test in Taipei was variety Tainon No. 8, transplanted on Augest 23. Sprays were applied on Oct. 7th and 8th at the rate of 1,200 1. per hectare with a pneumatic knapsack sprayer at the pressue of about 40 p. s. i. The treatment were randomized and replicated 6 times. The test plot was about 0.005 a. in area containing 1,000 hills of the plants. Heading of the plants started about 10 days after treatment. The results were examined on Oct. 24 by counting the number of the white ears. It was found that although 1,200 1. of spray per hectare has been the recommended amount, the deposits of spray on the stems were only fractional when applied with a pneumatic sprayer at the pressure of 40 p. s. i. The data of these tests were given in table 8.

Table 8. Field tests of the paddy borer control with some insecticides applied as a foliar spray at the rate of 1,200 1./hec.

Treatment and Concentration (%)	Per Cent Of White Ears Caused Primarily By The Paddy Borer[a]						
	Replicate						Average
	I	II	III	IV	V	VI	
Test in Chiayi, sprayed Sept. 11							
Untreated	0.99	0.89	1.48	1.08	—	—	1.11
Sumithion 0.1	0.99	0.16	1.27	0.44	—	—	0.71
Sumithion 0.05	0.16	0.38	0.25	0.15	—	—	0.24
Sumithion 0.05 Plus Endrin 0.05	0.10	0.14	0.22	1.03	—	—	0.37
Endrin 0.05	1.36	0.71	0.05	0.24	—	—	0.59
Parathion 0.05	0.86	0.83	0.58	0.38	—	—	0.66
Test in Taipei, sprayed Oct. 7 and 8							
Untreated	1.57	0.23	0.53	0.39	0.38	0.23	0.56
Sumithion 0.1	0.37	0.42	0.53	0.13	0.10	0.40	0.33
Sumithion 0.05	0.76	0.32	0.30	0.17	0.31	0.87	0.46
Sumithion 0.05 Plus Endrin 0.05	0.20	0.10	0.29	0.25	0.12	0.73	0.28
Endrin 0.05	0.36	0.17	0.12	0.28	0.42	0.26	0.27
Parathion 0.05	0.73	0.51	0.34	0.48	0.23	0.68	0.50

[a] Some of the white ears were caused by the rice stem borer, *Chilo suppressalis*.

The difference in percentage of the white ears caused by the pest between treatment was statistically analyzed and the results were given in table 9.

Table 9. Analysis of variance

Source Of Variation	D.F	Sum Of Square	Mean Square	F	Point Of Significance	
					5%	1%
Test in Taipei						
Treatment	5	0.4541	0.0908	1.4885	2.60	3.86
Replication	5	0.7180	0.1436	2.3541		
Eror	25	1.5249	0.0610			
Total	35	2.7960				
Test in Chiayi						
Treatment	5	1.8445	0.3689	2.2659	2.90	4.56
Replication	3	0.3189	0.1063	0.6529		
Eror	15	2.4420	0.1628			
Total	23	4.6054				

It is found from the data in table 9 that difference between treatments was not significant in both tests conducted in Chiayi and Taipei. This seemed to be due to various causes such as heading of the plants, the typhoon (in Chiayi), low population of the pest during the test period, too long interval of time between treatment and examination of the results during which period the insecticides used lost their residual effect, and inappropriate method of applying sprays (insufficient deposits of the toxicants on the stems). At any rate, before trying to conduct reliable field tests of comparative effectiveness of insecticides it seems necessary first to make detailed studies on timing of applying chemicals, methods of application, use of indicators for evaluating the effect of insecticides.

DISCUSSION AND CONCLUSIONS.—The data obtained in the present work indicate that when higher dosages (0.1%, 17 cc per hill) are used Sumithion appears to give somewhat better residual control of the borer. Yet, it seems difficult to obtain the persistence over 7 days with this material even at such a relatively higher dosage. Better residual control of the pest is obtained when Sumithion is combined with endrin; in this case 0.05 and 0.02 per cent appear to be adequate for Sumithion and endrin respectively. Endrin in this test again showed variable residual activity, and parathion gave rather poor residual control. On the other hand EPN exhibited promising results.

When applied in the soil at the heading stage of the plants lindane dust (3%, 5g. per hill) showed superior residual control to parathion, EPN, Sumithion and endrin (0.05% emulsions, 30 cc. per hill).

It was found from the results of these tests and the previous work (Lee, 1961) that residual activity of insecticides tested against the newly hatched larvae varied considerably with stages of growth of paddy plants, and possibly with different external conditions of the plants. At the heading stage many insecticides when applied as a foliar spray showed much poorer residual effect. This seems to be

owing to the fact that the larvae on such plants readily crawl into the lower part of the ear that is still enveloped by the flag leaf sheath and feed in the glumes or the axis of the ear in which little or less toxicant is present. At any rate, it is important when testing residual toxicity of insecticides that plants at different stages of development be used. It is also essential in conducting comparative residual toxicity test of insecticides that tillers in the hill be well standardized. This is especially important when a test is to be conducted in rather inextensive scale.

The results of trails to study mode of action of residues of endrin and parathion indicated that surface residue of endrin did not appear to show any toxic effect on the larvae, while that of parathion soon after spraying seemed to possess a slight toxic action on the newly hatched larvae.

It was found from the results of the field tests that when sprays were applied with a pneumatic knapsack sprayer at the rate of 1,200 l. per hectare and at the pressure of about 40 p. s. i., deposit of the spray on the stem was only fractional, possibly resulting in little insecticidal activity. Therefore, other methods of applying insecticides should be studied.

No significent difference between Sumithion, endrin, parathion, and endrin plus Sumithion treatments was determined in two field tests conducted at Taipei and Chiayi at and before heading stage of the plants. This seemed to be owing to various causes such as heading of the plants, the typhoon, low population density of the pest, too long interval of time between spraying and examination of the results, and inappropriate method of applying insecticides. Before trying to conduct reliable field tests of comparative effectiveness of insecticides it seems necessary first to make detailed studies on timing of applying chemicals, method of application, use of indicators for evaluating the effect of insecticides.

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幾種殺蟲劑對於初孵化三化螟幼蟲之殘效試驗

李淳陽　洪文堯

中文摘要

前次試驗 (Lee. 1961) Sumithion 對三化螟初孵化幼蟲顯示優異之初效 (initial effect)，但殘效期間則僅約一星期。於本試驗中，Sumithion 以較高濃度或用量使用時 (0.1%，每欉 17 cc)，得到較佳之殘效，然其有效期間似仍不能超過一週。與 endrin 混合使用，殘效可加長，其濃度 Sumithion 0.05%，endrin 0.02%似已足够。Endrin 單獨使用時，其殘效與前次試驗相同，頗有變異。Parathion 之殘效並不理想。EPN 則有希望。

水稻露穗期施行土壤處理，其殘效 lindane粉劑 (3%，每欉 5 g) 長於 Parathion, EPN, Sumithion 及 endrin (0.05%乳釋液，每欉 30 cc)。

就各次試驗結果發現，水稻之生長期影響藥劑對三化螟初孵化幼蟲之殘效頗大。植株外部狀態似亦有此可能。

在水稻露穗時噴藥，多種藥劑之殘效均不理想。此或由於幼蟲常侵入嫩穗 (於苞鞘中) 嚙食花器及穗軸所致，此時該部份仍包藏於苞鞘之內，藥毒滲入者可能甚少，甚或全無藥劑存在。因此從事殘效試驗時，各種生長狀態之水稻均需一一比較，每欉各株間之生長情形亦應力求統一，小規模試驗尤應注意此點。

由 endrin 和 parathion 之殘留成分作用程序 (mode of action) 之初步試驗結果顯示，endrin 之表面殘留成分對三化螟初孵化幼蟲脚部之接觸和蟲體燻蒸不引起毒效。噴後不久之 parathion 似乎有些微之毒作用，唯由接觸或燻蒸何者所引起，尙未探悉。

田間試驗時發現，以自動式噴霧器，壓力約 40 p. s. i.，在每公頃 1,200 公升之藥量下噴於水稻，其莖部着藥量甚少，此可能爲藥劑防治效果不良原因之一，因此，藥劑之施佈方法有加以研究之必要。

在臺北地區水稻近露穗及嘉義地區水稻露穗時所進行之田間藥劑試驗，未得顯著結果 (使用藥劑爲 Sumithion, endrin, parathion 及 Sumithion 加 endrin)。其可能之原因甚多，例如正出穗之水稻，遭遇颱風，自然被害率太低，噴藥至調查結果相隔時日過長或噴藥方法不適當等等。故於進行田間藥劑比較試驗之前，似應先予充分研究噴藥時期，用藥方法及如何使用指示物以測定試驗結果等問題。

民國五十一年度臺灣省中南部二期作田間藥劑防治三化螟 (*Schoenobius incertulas*)、二化螟 (*Chilo suppressalis*) 與大螟 (*Sesamia inferens*) 試驗報告

陶　家　驊

夫螟災之發生，視氣候與水稻栽培制度而異，苟欲求得最經濟防治成果，事先必須洞察螟害發生猖獗誘因，然後針對螟蟲爲害弱點及時施用藥劑防治，始得事半功倍之效，否則好高騖遠漫談防治，實無補於實際，如果忽視螟害猖獗誘因，認爲螟蟲一旦出現少數時，竟使成巨災，若以觀其全貌，則本省境內早爲螟害所威脅，無法種植水稻矣。如今年二期作普遍受螟害甚爲輕微，誠爲光復以來罕見。至於螟害發生猖獗誘因，容待另文發表，爰將本年二期作田間藥劑防治試驗結果，草成斯文，藉以拋磚引玉，尙望同道予以指正是幸。

本試驗承農復會補助經費，承劉組長廷蔚暨羅技正宗爵，蒞臨指示，又承本系同仁通力合作協助田間試驗及調查工作，並蒙湯技佐慶銓統計分析及王技術助理勝鴻繕寫，均此一併致謝。

試驗方法及材料

民國五十一年在屏東長治鄉，臺南柳營鄉，嘉義市臺斗坑及南投草屯四處，舉行二期作田間藥劑防治水稻螟蟲試驗，每處藥劑處理10個及對照5個，每處理混合 0.027% Tuzet 並以病蟲兼治之，隨機排列，重複4次，以 Boss 牌動力噴霧器，噴射殺蟲劑。

1. 屏東長治鄉試驗區：參加殺蟲劑5種，即 50% Lebaycid 乳劑，45% EPN 乳劑，85% Sevin 可濕性粉劑，19.5% Endrin 乳劑及 50% Ekatox 乳劑，每種殺蟲劑施用濃度兩種除 Sevin 0.10% 及 0.20% 外，餘均爲 0.025% 及 0.05%。小區面積 5 m×5 m (25 m^2)，每小區20行，每行20穴，共400穴，行株距 25 cm×25 cm，供試驗品種嘉南1號，插秧期7月17日，施藥時期8月17日，9月7日及9月26日，先後共3次，每公頃施用稀釋液量第一次爲 1,000 公升，第二及第三次爲 1,500 公升。於10月13～15日調查各處理任選50欉，藉以測定防治螟蟲效果，對照區任意拔除白穗 100 株外，各處理凡有白穗者悉拔携回室內剖檢三種螟蟲之幼蟲數。收割期10月18～19兩日，各處理取樣稻谷1公斤，携回嘉義晒乾後計算單位面積稻谷產量。

2. 臺南柳營鄉試驗區：參加殺蟲劑中將 Sevin 改爲 50% Sumithion 外餘均相同，每種殺蟲劑施用兩種濃度爲 0.025% 及 0.05%，小區面積及株行距與前相同，供試驗品種嘉南8號，移植時期7月4日，施藥時期8月1日，9月4日及13日共3次，每公頃施用稀釋液量亦與上相同。於9月29日、30及10月1日3日，各處理任意調查 100 欉。剖檢各處理三種螟蟲之幼蟲數及計算單位面積稻谷產量步驟與前相似，收割期10月18日。

3. 嘉義市臺斗坑試驗區：參加殺蟲劑中 Sumithion 改爲 Imidan 乳劑外除均與上相似，施用藥劑濃度與上相似。小區面積 5 m×4 m (20 m^2) 每小區20行，每行16穴，共320穴。供試驗品種嘉農育242號，移植時期8月8日，施藥時期9月2、9及20日三次均在後期舉行，每公頃稀釋液量均爲 1,500 公升。11月13及14兩日任意調查各處理 100 欉。剖檢白穗中三種螟蟲之幼蟲數與柳營試驗區相似，收割日期11月29～30兩日，單位面積稻谷產量之計算亦與前相似。

4. 南投草屯試驗區：參加殺蟲藥劑中 Imidan 改爲 20% Dimecron 乳劑餘均與前相似。

施用藥劑濃度亦與前相似，小區面積及行株距與臺南柳營試驗區相同，供試驗品種嘉農育242×臺中 65 (F_1)，挿秧日期 7 月 28 日，施藥日期 8 月26日，9 月18日及10月 6 日三次，每公頃施用稀釋液量與臺南柳營試驗區相似，各處理任意調查50欉，於10月28～31日舉行，該區各處理中螟害鮮有發生，故未舉行調查三種螟蟲之幼蟲數，收割日期11月 9 日，單位面積稻谷產量之計算與前相同。

結　　論

茲據四處試驗結果，螟災發生與自然環境及水稻栽培制度有密切關係，其中以臺南柳營及嘉義臺斗坑試驗區所受螟害較其他試驗區爲烈，蓋因栽培制度與品種影響所致，如在來稻栽培面積較多，蓬萊種其孕穗期適值第五代螟蛾發生而引起也，屏東長治鄉試驗區所受災害次之，卓屯試驗區螟害均未發生。蓋以應用藥劑防治螟蟲者必須詳加研究螟蟲發生環境，然後始得最經濟和收效亦宏，否則得不償失。就以產量而言，藥劑處理除南投卓屯試驗區外與對照區均有顯著差異。藥劑處理間差異不顯著，惟濃度間鮮有差異，高濃度稍較低濃度爲優， 0.20% Sevin WP，防治螟蟲效果與 0.05% Lebaycid 乳劑，0.05% Sumithion 乳劑，0.05% Endrin 乳劑，及 0.05% Imidan 乳劑相等，屏東長治鄉試驗區以 0.20% Sevin WP 處理產量最高，臺南柳營試驗區以 0.05% Endrin 乳劑處理爲最高，臺斗坑試驗區以 0.05% Imidan 處理爲最高，本期水稻受螟蟲爲害，以三化螟爲主，二化螟次之，大螟更次之，詳見表一：

表一　中南部田間藥劑防治二期作水稻三化螟、二化螟及大螟蟲密度消長之調查表

Table 1. Investigation on the Population of Three Kinds of Rice Borers Occurred on the Second Rice Crop in Various Treatments in Central and South Taiwan in 1962

藥劑處理 Chemical	三種螟蟲爲害白穗百分比 Percentage of white heads infested by three kinds of rice borers			三種螟蟲之幼蟲數 No. of three kinds of rice borer's larvae			三種螟蟲百分比 Ratio of three kinds of rice borers		
	Paddy borer	Rice stem borer	Purplish stem borer	Paddy borer	Rice stem borer	Purplish stem borer	Paddy borer	Rice stem borer	Purplish stem borer
1. 屏東縣長治鄉試驗區 Experiment at Cheng-Tze District, Pintung county									
0.05% Lebaycid EC	100.0	0	0	30	5	0	85.7	14.3	0
0.025% Lebaycid EC	100.0	0	0	34	10	1	75.6	22.2	0
0.05% EPN EC	100.0	0	0	37	0	0	100.0	0	2.2
0.025% EPN EC	98.3	1.8	0	26	0	0	100.0	0	0
0.20% Sevin WP	96.7	3.3	0	37	1	0	97.4	2.6	0
0.10% Sevin WP	100.0	0	0	56	13	1	80.0	18.6	1.4
0.05% Endrin EC	100.0	0	0	18	0	0	100.0	0	0
0.025% Endrin EC	100.0	0	0	20	0	0	100.0	0	0
0.05% Ekatox EC	95.8	4.2	0	5	0	0	100.0	0	0
0.025% Ekatox EC	97.3	2.7	0	9	0	1	90.0	0	10.0
Check	98.0	2.0	0	73	27	1	72.2	26.7	1.0
2. 臺南縣柳營鄉試驗區 Experiment at Liu-Yin District, Tainan county									
0.05% Lebaycid EC	48.2	43.8	8.4	24	20	4	50.0	41.7	8.3
0.025% Lebaycid EC	69.0	26.4	4.6	20	9	3	62.5	28.1	9.4

0.05% EPN EC	78.2	18.2	3.6	20	5	0	80.0	20.0	0
0.025% EPN EC	83.3	16.7	0	51	11	0	82.3	17.7	0
0.05% Sumithion EC	29.3	53.7	17.1	8	16	3	29.6	59.3	11.1
0.025% Sumithion EC	66.7	26.4	6.9	25	24	0	51.0	49.0	0
0.05% Endrin EC	66.2	27.7	6.2	15	5	2	68.2	22.7	9.1
0.025% Endrin EC	60.7	32.1	7.1	30	14	3	63.8	29.8	6.4
0.05% Ekatox EC	46.9	51.0	2.0	9	8	0	52.9	47.1	0
0.025% Ekatox EC	56.4	34.0	9.6	33	19	7	55.9	30.2	11.9
Check	67.1	30.6	2.3	76	35	3	66.7	30.7	2.7
3. 嘉義市臺斗坑試驗區 Experiment at Tai-Tou-Keng, Chia-Yi Township									
0.05% Lebaycid EC	80.6	19.4	0	38	17	1	67.9	30.4	1.8
0.025% Lebaycid EC	90.7	9.3	0	99	26	2	78.0	20.5	1.6
0.05% EPN EC	95.0	5.0	0	31	10	0	75.6	24.4	0
0.025% EPN EC	86.2	13.8	0	43	27	0	61.4	38.6	0
0.05% Imidan EC	95.9	4.1	0	4	3	2	44.4	33.3	22.2
0.025% Imidan EC	96.4	3.6	0	56	27	2	65.9	31.8	2.4
0.05% Endrin EC	100.0	0	0	23	5	0	82.1	17.9	0
0.025% Endrin EC	80.0	20.0	0	28	14	0	66.8	33.3	0
0.05% Ekatox EC	92.1	7.9	0	13	8	0	61.9	38.1	0
0.025% Ekatox EC	73.3	26.7	0	35	61	4	35.0	61.0	4.0
Check	81.6	18.4	0	217	67	4	75.3	23.3	1.4

討 論 與 結 論

藥劑處理有效穗及白穗率除屏東長治鄉及南投草屯試驗區外與對照區均有顯著差異，死孕及後期枯心苗率均無顯著差異；稻谷產量除南投草屯試驗區外，藥劑處理與對照區差異亦顯著，但藥劑處理差異不顯著。屏東長治鄉試驗區藥劑處理每公頃產量3,320至3,680公斤對照區 2,880至3,040公斤；臺南柳營試驗區4,000至4,600公斤對照區3,280至3,680公斤；嘉義市臺斗坑試驗區4,050至4,450公斤對照區3,500至3,350公斤；南投縣草屯試驗區 6,080至6,200公斤對照區5,920至6,080公斤；除南投縣草屯試驗區外，高濃度藥劑處理產量均較低濃度處理爲高，惟差異不顯著。詳見表二：

表二　中南部田間藥劑防治二期作水稻三化螟、二化螟及大螟蟲試驗之結果

Table 2. Effectiveness of Several Insecticides Applied Against *S. incertulas*, *C. suppressalis* and *Sesamia inferens* on the Second Rice Crop in Central and South Taiwan in 1962

藥劑處理 Chemical	每欉有效穗數(平均) No. of effective panicles per hill (Av.)	後期枯心苗率 Percentage of later dead hearts		白穗率 Percentage of white heads		死孕率 Percentage of dead boots		產量 Yield of Rice (kg/ha)	指數 Index
		%	Angle	%	Angle	%	Angle		
1. 屏東長治鄉試驗區 Experiment at Cheng-Tze District, Pintung county									
0.05% Lebaycid EC	13.1	0.6	4.2	1.2	6.2	0.04	0.6	3,320	115.3
0.025% Lebaycie EC	12.6	0.9	5.5	1.3	6.4	0	0	3,320	115.3
CK	10.8	1.1	6.0	2.5	9.1	0.10	1.4	2,880	100.0

0.05% EPN EC	12.9	0.9	5.0	1.0	4.8	0.04	0.4	3,520	115.8
0.025% EPN EC	12.8	0.7	4.6	1.3	6.6	0	0	3,440	113.2
CK	11.5	1.0	5.7	1.4	6.4	0	0	3,040	100
0.20% Sevin WP	13.0	0.9	5.3	1.4	6.5	0	0	3,680	121.1
0.10% Sevin WP	12.5	1.0	5.7	2.9	9.2	0.04	0.6	3,640	119.7
CK	12.1	1.2	6.3	2.3	8.7	0.08	1.0	3,040	100
0.05% Endrin EC	13.1	1.1	5.7	0.8	2.6	0.04	0.6	3,520	122.2
0.025% Endrin EC	12.8	1.1	6.0	1.0	5.6	0	0	3,400	118.1
CK	11.3	1.5	7.0	2.2	8.4	0.20	1.6	2,880	100
0.05% Ekatox EC	12.8	0.6	4.3	1.2	6.1	0.04	0.4	3,640	126.4
0.025% Ekatox EC	12.4	1.1	5.9	0.7	4.8	0.08	0.7	3,480	120.8
CK	11.5	1.0	5.5	2.1	8.2	0.04	0.6	2,880	100
L. S. D. 5%	0.9		1.9		3.0		2.1	242.4	
L. S. D. 1%	1.2		2.5		4.0		2.1	324.3	

2. 臺南縣柳營鄉試驗區

Experiment at Liu-Yin District, Tainan county

0.05% Lebaycid	11.7	4.2	11.9	1.5	6.7	0.4	2.9	4,480	128.7
0.025% Lebaycid	11.8	5.2	13.1	1.5	6.8	0.2	2.7	4,320	124.1
CK	10.5	6.9	15.4	5.8	13.8	1.2	5.6	3,480	100
0.05% EPN EC	11.5	4.5	12.0	0.2	4.5	0.3	3.2	4,040	123.2
0.025% EPN EC	10.9	5.3	13.3	1.1	6.0	0.3	2.7	3,680	112.2
CK	9.9	7.9	16.3	7.6	15.0	1.5	6.9	3,280	100
0.05% Sumithion EC	11.4	4.6	12.3	0.7	4.1	0.2	2.5	4,160	125.3
0.025% Sumithion EC	11.3	4.1	11.4	1.5	6.9	0.2	2.5	4,000	120.5
CK	9.9	6.5	14.5	9.2	17.5	1.3	6.0	3,320	100
0.05% Endrin EC	12.1	3.1	9.8	0.4	3.2	0.4	2.9	4,600	135.3
0.025% Endrin EC	11.8	4.4	12.0	0.8	5.0	0.3	3.0	4,280	125.9
CK	9.6	6.2	14.2	7.4	15.7	1.5	6.8	3,400	100
0.05% Ekatox EC	11.7	4.5	12.2	0.6	4.4	0.4	3.5	4,200	123.5
0.025% Ekatox EC	11.4	5.3	13.5	0.4	3.2	0.2	2.3	4,200	123.5
CK	9.8	6.8	15.0	8.7	16.9	2.0	8.1	3,400	100
L. S. D. 5%	0.9		3.0		2.5		2.2	355.2	
L. S. D. 1%	1.1		4.0		3.4		3.0	477.5	

3. 南投縣草屯鎮試驗區

Experiment at Tsao-Tuong District, Nan-Tou county

0.05% Lebaycid EC	15.0	0.6	4.1	0	0	0	0	6,120	103.4
0.025% Lebaycid EC	15.6	0.5	3.6	0.2	1.2	0	0	6,080	102.7
CK	14.6	1.2	6.0	0	0	0	0	5,920	100
0.05% EPN EC	16.2	0.7	4.9	0.1	0.9	0	0	6,200	103.3
0.025% EPN EC	15.9	0.7	4.6	0	0	0	0	6,080	101.3
CK	14.7	0.6	4.2	0	0	0	0	6,000	100
0.05% Dimecron EC	15.8	0.6	4.5	0	0	0	0	6,150	101.8
0.025% Dimecron EC	14.6	0.9	5.0	0.1	1.4	0.04	0.6	6,080	100.7
CK	15.6	1.0	5.8	0	0	0	0	6,040	100
0.05% Endrin EC	15.3	1.0	5.7	0.1	0.9	0.04	0.4	6,080	100.7
0.025% Endrin EC	16.6	0.9	5.4	0	0	0	0	6,080	100.7
CK	14.9	0.8	4.6	0	0	0.03	0.4	6,040	100
0.05% Ekatox EC	15.6	0.4	3.1	0	0	0	0	6,080	100.0
0.025% Ekatox EC	16.1	0.5	3.3	0	0	0.03	0.4	6,080	100.0
CK	15.2	1.1	5.9	0	0	0	0	6,080	100
L. S. D. 5%	1.6		2.6					213.4	
L. S. D. 1%	2.1		2.7					285.6	

4. 嘉義市臺斗坑試驗區
Experiment at Tai-Tou-Keng, Chia-Yi Township

0.05% Lebaycid EC	11.5	0.8	4.2	1.6	6.9	0.8	4.8	4,150	123.9
0.025% Lebaycid EC	11.4	1.4	6.2	2.4	8.5	0.5	4.1	4,350	129.9
CK	9.5	1.7	6.8	7.8	16.0	2.4	8.6	3,350	100
0.05% EPN EC	11.8	2.1	6.6	0.7	4.6	0.7	4.5	4,300	114.7
0.025% EPN EC	10.9	1.6	6.5	1.3	6.6	1.3	6.3	4,050	108.0
CK	9.8	1.7	7.1	6.9	15.0	1.3	6.3	3,750	100
0.05% Imidan EC	11.0	1.3	6.1	1.0	5.6	0.6	4.2	4,450	130.9
0.025% Imidan EC	10.9	1.0	4.9	2.0	8.1	0.9	5.1	4,200	123.5
CK	9.5	2.1	7.6	8.1	16.1	1.6	7.0	3,400	100
0.05% Endrin EC	11.8	1.2	5.4	0.7	4.9	0.5	3.6	4,300	124.6
0.025% Endrin EC	11.4	1.7	7.1	1.7	7.4	1.0	5.3	4,200	121.7
CK	9.7	1.7	7.0	5.4	13.3	2.8	8.8	3,450	100
0.05% Ekatox EC	11.2	1.0	4.5	0.6	4.1	0.2	5.0	4,200	118.3
0.025% Ekatox EC	11.1	1.1	5.7	1,9	7.7	0.5	3.8	4,150	116.9
CK	10.1	1.9	7.5	5.7	13.7	1.4	6.6	3,550	100
L. S. D. 5%	1.0		2,5		2.8		2.1	334.1	
1%	1.3		3.3		3.7		2.8	447.0	

摘　　要

本試驗進行期中，依照各地螟蟲發生環境及水稻栽培制度而舉行，先後施藥三次，如嘉義市臺斗坑試驗區注意後期螟蟲發生防治，所謂孕穗及抽穗時期應用藥劑防治無效之高論，足以證明其與實際情形不符，一般農民防治水稻螟蟲均注意前期，而忽視後期，往往釀成災害，比比皆是，以致功虧一簣，凡吾同道應加警惕。本期水稻所受螟蟲爲害調查結果，以三化螟蟲爲主，二化螟蟲次之，大螟鮮有發生。茲據本試驗結果，諸藥劑處理防治螟蟲成效，大致相同，其中以 50% Lebaycid 乳劑（來必死）防治螟蟲之效果，不亞於其他殺蟲劑，且對人畜毒力低，以防治螟蟲安全計，頗有推廣價值。Imidan 乳劑（也滅得）屬於有機磷類，對於人畜毒力亦低，經在室內及田間局部試驗結果，防治螟蟲成效亦佳，亦可介紹農民普遍實施應用。EPN 防治螟蟲固屬有效，對人畜毒力，雖遜於巴拉松，惟施用者應謹慎，否則時有中毒發生。Endrin 在田間防治成效變異鮮有發生。據某氏在室內研究結果，防治螟蟲效果，變異甚大，令人費解。至於施藥時期及次數，視螟蟲發生環境及其爲害狀況而決定，禾苗生育在三四星期內，視其初期爲害徵象（捲心）及猖獗情形，施藥一次或二次。認爲最重要時期，如孕穗及抽穗期中，每間隔 7 天或10天施用藥兩次或三欲，同時應注意水稻品種間孕穗及抽穗期長短，斟酌實際情形，以增減施藥次數。禾苗期施用藥劑有效濃度爲0.025%，每公頃施用稀釋液量 1,000 公升，孕穗及抽穗時期施藥劑濃度 0.05%，每公頃施用稀釋液量爲 1,500 公升。

Control of *Schoenobius incertulas* Walker and *Chilo suppressalis* Walker and *Sesamia inferens* Walker on the Second Rice Crop in Central and South Taiwan in 1962

By

CHIA-HWA TAO

Summary

The field tests were carried out at Pintung, Tainan, Chia-yi and Nan-tou rice areas, to determine the effectiveness of several insecticides and of concentrates used against these pests on the second rice crop, namely, emulsifiable concentrate of 50% Lebaycid, 45% EPN, 20% Dimecron, 36% Imidan, 50% Sumithion and 19.5% Endrin, and 85% Sevin wettable powder. The spray wash depended upon environmental conditions and agricultural practices when these pests attacked this crop from nursery to mature stage. Occasionally these pests concentrated to attack this crop, during which it was boot stage or negligible tillering stage under favorable conditions and caused to be more severious pests of rice than the tillering stage, among which the paddy borer (*Schoenobius incertulas*) was responsible for damage to rice throughout Central and South part of Taiwan this year. In the Tai-tou-keng trial, emulsion spray was made for three times with auto-knapsack mist blower, at 7–10 days of intervals, when this pest attacked this crop at boot stage or negligible tillering stage. The rate of application was 1,500 liters of dilution per hectare, respectively. All insectides have proven to give about equal effect against these pests in the paddy fields. In order to control of these pests on boot stage was as important as tillering stage. According to the yields of rice from various regional tests of treatments, there were no significant differences between the insecticides and the concentrates used. It yielded significantly higher than the untreated plots. The yield of rice from Cheng-tze trial in Pintung was 3,320 to 3,680 kg per hectare as compared with 2,880 to 3,040 kg in the check, but 0.20% Sevin spray in yield produced highest in the treatments; from Liu-yin trial in Tainan was 4,000 to 4,600 kg per hectare as compared 3,280 to 3,680 kg in the check, of which 0.05% Endrin spray in yield was highest; from Tsao-tuong trial in Nan-tou was 6,080 to 6,200 kg per hectare as compared with 5,920 to 6,080 kg in the check, there was no significant increase between treatments and untreated plot, because, the infestation of rice by these pests was not as affect as other regional trials; from Tai-tou-keng trial in Chia-yi was 4,050 to 4,450 kg

per hectare as compared with 3,650 to 3,750 kg in the checks, of which the 0.05% Imidan spray in yield was higher than other treatments. Spray wash with the exception of Tai-tou-keng trial was applied for three times with auto-knapsack mist blower from tillering to mature stage depending on the degree of infestation in the paddy fields. The rate of application early in the season was 1,000 liters of dilution per hectare, and the first application was followed by a second and a third time. Since the fifth generation of the paddy borer started to attack the rice crop during boot stage or negligible tillering stage, the rate of application on boot stage was increased to 1,500 liters of dilution per hectare for each of the last two treatments.

In the experiments, Lebaycid and Imidan sprays were equally effective in controlling these pests, if their costs are not as expensive as other pesticides they may be recommended for large scale rice pest control in Taiwan, due to its long residual effect and their toxicity to human is lower than both of organic phosphate compounds and chlorinated hydrocarbon compounds consisting of parathion and endrin which have been extensively used for rice pest control in Taiwan rice areas at present.

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